RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

BRIDGES - BUILDINGS - CONTRACTING - SIGNALING - TRACK

New Series, Vol. VIII
Old Series, Vol. XXVII | *Chicago* NOVEMBER, 1912 *New York* | No. 11

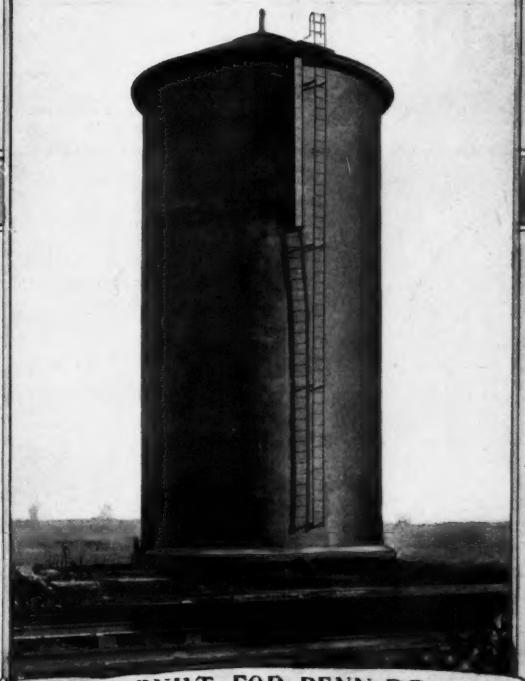
REINFORCED CONCRETE TANKS

ARE NO LONGER AN INNOVATION IN RAILWAY SERVICE.

We Guarantee Our Tanks
UNDER
TRUST COMPANY BOND
TO BE
Absolutely Water Tight.

OUR TANKS MAKE GOOD BECAUSE THEY ARE

PROPERLY DESIGNED
—
CAREFULLY CONSTRUCTED WITH BEST MATERIALS, FORMS AND WORKMANSHIP OBTAINABLE



TANK BUILT FOR PENN. R.R. CO., IN 1909

PERMANENT
—
SATISFACTORY IN SERVICE
—
DEVOID OF MAINTENANCE COSTS
—
ATTRACTIVE IN APPEARANCE
—
ECONOMICAL

THE McCOY PATENT FORMS & METHODS OF ERECTION ELIMINATE IMPERFECTIONS.
WRITE FOR BOOKLET OF CONCRETE FACTS CONCERNING CONCRETE TANKS.

STEEL CONCRETE CONSTRUCTION CO.
1302-3 BERGER BLDG PITTSBURGH, PA.

A man is known by the company he keeps and a workman by the tools he uses

HUBBARD

Track tools have earned an enviable reputation for service and dependability. A **Hubbard** shovel will hold its edge in sand, gravel and rock.

Hubbard track chisels are made of correctly tempered crucible tool steel. They will **not** chip off with the first blow of the spike maul.

If you wish to keep **your** temper, buy track chisels which will keep **their** temper—i. e., **Hubbard** track chisels.

HUBBARD & CO., Pittsburgh, Pa.

OKONITE
TRADE MARK.

Insulated Wires and Cables

will continue giving satisfactory service long after their purchase has been forgotten—made in but *one* grade—the *best*.

Look for the Ridge

A distinguishing mark on *genuine* OKONITE insulation consists of a single ridge running the entire length of the wire.

The Okonite Company
252 Broadway, New York

Central Electric Company,
General Western Agents
320-326 S. 5th Ave., Chicago

Franklin Manufacturing Company

85% MAGNESIA
LOCOMOTIVE
LAGGING

Asbestos Supplies and Specialties for Railroads

WOOL and COTTON
WASTE
Perfection Journal
BOX PACKING

Franklin - Pennsylvania

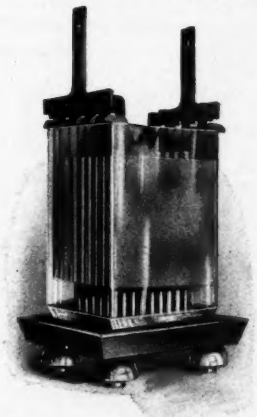
USL TRADE MARK

THE UNITED STATES LIGHT AND HEATING CO.

(Formerly National)

Storage Batteries For Signal Service

U-S-L batteries discharge only when the signal circuit is closed. Although the service be extremely intermittent they retain their capacity—no energy being dissipated uselessly by internal discharge. This desirable feature is secured by our advanced methods of manufacture and the absolute purity of our raw materials.

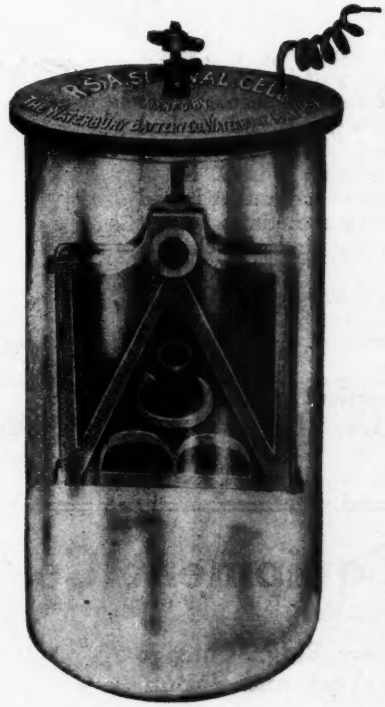


The U. S. Light & Heating Co.

GENERAL OFFICES: 30 Church Street, New York
FACTORY: Niagara Falls, New York

BRANCH OFFICES AND SERVICE STATIONS:

New York Boston Buffalo Cleveland Detroit Chicago St. Louis San Francisco



Each

Schoenmehl R. S. A. Battery Cell *is Perfect*

Conception

The **Schoenmehl** cell was evolved from knowledge based on many years of experience. The requirements were known absolutely.

Design

Infinite care, years of time, scads of money, all were expended in making the design. Experience has shown completely that the design carries out the conception.

Construction

Expert supervision, expert workmen, and scientific modern methods enable us to correctly construct each cell according to the design.

Result

A battery cell which stands up;—not only as an average, **but in each individual case.**

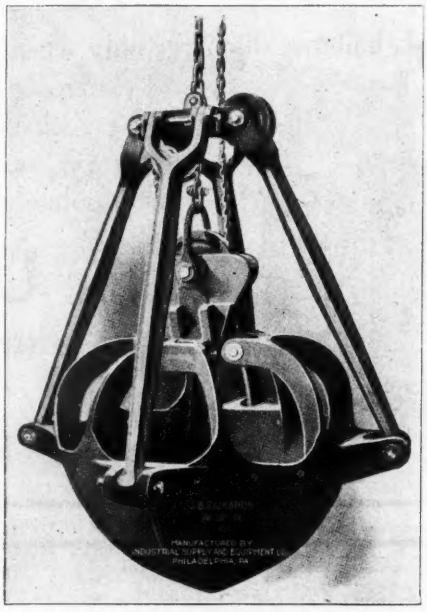
Waterbury Battery Company

Waterbury, Conn.

Chicago Sales Office
BRYANT ZINC CO., 600 Orleans St.

New York Sales Office
BRYANT ZINC CO., 50 Church St.

THE BUCKET
AND WHAT THE OWNER SAYS



Gentlemen:

In regard to the work done by "Rickards Orange Peel Bucket," which we purchased of you, would say that it was highly satisfactory in every particular.

We used this bucket from a small derrick-scow on a submerged ledge, that we were blowing out of the head of the Thames River at Norwich, Conn. In order to get on this ledge we were forced to go under a low bridge about 30 feet high; in fact, we had to work directly under the bridge most of the time. This fact made it necessary for us to use a small derrick and therefore a small bucket.

We drilled and blew this rock, but found much to our disgust that it would not open up in any kind of shape, but would first crumble and crack in all directions. After blowing it a number of times we went to work with an Orange Peel, but found that the design of this bucket in so small a size interfered with its getting a proper hold on the stone; in fact, we found a diver would pick up into a scale-box more stone in a day than we could dig.

About that time I heard of your bucket, and as soon as I saw it, I knew it would dig rock or bust, so my people bought it, as you know, and we consider it the best bucket for this line of work we have ever seen. After buying the Rickards Bucket we soon finished our contract, and had we had it at first we would have been a good many dollars in.

In regard to the strength of this bucket, would say that it is O. K. I have often seen it come out of the water fast to a piece of ledge that it had pulled out, and would weigh easily four tons, and have sometimes seen it stick the hoister before it would let go. In fact, given any kind of a chance, it can't let go.

If this letter is of any use to you, why use it, for I have great faith in your bucket after the bad job it pulled us through.

(Name on application)

If you want to know more about the most practical "Orange Peel Bucket" write us.

The Industrial Supply & Equipment Co.

407 Sansom Street, Philadelphia, Pa.

Agents—J. E. CHISHOLM, 350-55 Old Colony Bldg., Chicago
FRANK D. MOFFAT & CO., New York and Boston

Our guarantee, "more yards per day under like conditions than with any other bucket."

RAMAPO

Automatic Safety Switch Stands Are Manufactured Only by the RAMAPO IRON WORKS

Write for descriptive catalogues on **Switch Stands, Switches, Frogs, Guard Rail Clamps, Etc.**

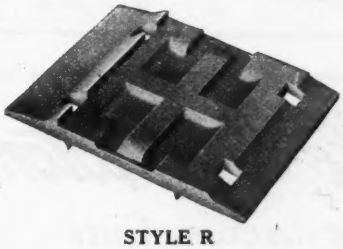
Manganese Track Work a Specialty

RAMAPO IRON WORKS

Main Office: Hillburn, N. Y.
Works: Hillburn, N. Y., and Niagara Falls, N. Y.

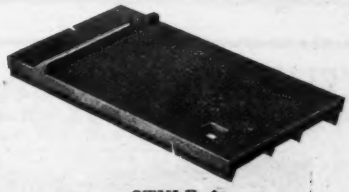
ROLLED STEEL SHOULDER TIE PLATES

Flanged and Flat Bottom



STYLE R

Our Catalog Describes 20 Types of Tie Plates



STYLE A

THE HART STEEL COMPANY

ELYRIA, OHIO

PLATES ROLLED BY THE ELYRIA IRON & STEEL CO.

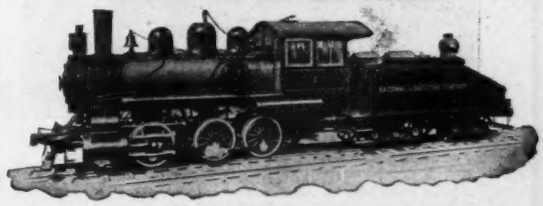
BROADWAY CENTRAL HOTEL

Broadway, corner Third Street
IN THE HEART OF NEW YORK
Only Medium Price Hotel left in New York.
Special attention given to ladies unescorted
SPECIAL RATES FOR SUMMER
OUR TABLE is the foundation of our enormous business.
AMERICAN PLAN, $2.50 UPWARDS
EUROPEAN PLAN, $1.00 UPWARDS
Send for Large Colored Map of New York, FREE.
DAN. C. WEBB, Proprietor

The Only New York Hotel Featuring American Plan
Moderate Prices. Excellent Food. Good Service.

LOCOMOTIVES

OF EVERY DESIGN
BROAD AND NARROW GAUGE

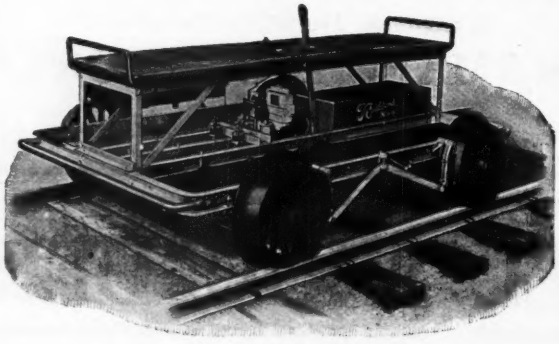


For Yard Switching, Freight and Passenger, Logging Contractors' Service. Write us

Vulcan Iron Works, Wilkes-Barre, Pa.

WE HAD IT ALL FIGURED OUT

We Knew That if we took the well-known *"Rockford"* Engine, and mounted it in a welded steel channel frame and eliminated dry cells, spark coil and timer, substituting therefor Magneto Ignition, and eliminated chain drive to cam shaft, substituting therefor direct drive through spiral gears, enclosed and running in oil



No. 4 Rockford Magneto Car

WE WOULD HAVE A WINNER IN THE

"Rockford"

RAILWAY MOTOR CAR

SEND FOR CATALOGUE NO. 40
AND CIRCULARS NOS. 103 - 104 - 105 - 116

Chicago Pneumatic Tool Company

CHICAGO 1010 Fisher Bldg. — BRANCHES EVERYWHERE — NEW YORK 50 Church St.

THE MIGHTY FAIRMONT

GASOLINE ENGINES FOR HAND CARS

The FAIRMONT WAY
6 MEN, PUSH-CAR & 45 TIES HANDLED SUCCESSFULLY WITH 3 H.P. FAIRMONT ENGINE

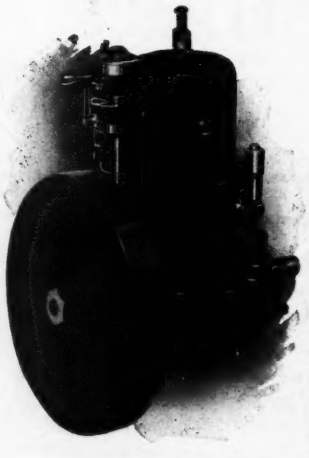
The FAIRMONT ENGINE
SAME CREW STARTING OUT TO WORK

The Fairmont Way.
Runs either way on track without turning car around.
Starts a big load without pushing the car.
Fully equipped and can be put on car in two hours and run.
Great Power—Light Weight.
We make a special car for Roadmasters' Inspection purposes.
Write today for full particulars and easy payment plan.

FAIRMONT MACHINE CO., Fairmont, Minn.

Belle Isle Motors

For Section Cars



4 H. P.
(Reversible)
Weight with all attachments
195 lbs.

Price complete with engine accessories, reverse clutch, sprockets and chain
$92.20

This 4 to 5 H. P., sturdy, powerful, absolutely reliable, smooth running, compact engine is easily installed on the standard Hand or Push Car with ordinary tools.

2½ H. P. for Velocipedes. Weighs 73 lbs — *Catalog Free*

Concrete Form & Engine Co.

502 Wayne County Bank — DETROIT, MICH.

"Never Compare Prices without Comparing Quality—You'll find more difference in Quality than in Price"

"COES" Genuine Wrenches

Cost what they may—are Worth what they Cost.

You pay perhaps 5% more for a "Coes" Genuine Wrench than some others but gain 30% extra strength, life and service.

If some one offers you a cheaper wrench, look for the reason behind the price reduction—there always is a reason and it's almost sure to be at the expense of the product.

The "COES"

Offers Long Convenient Service.

In every "Coes" Wrench, from the 4" Steel Handle to the 72" Key Model, (the largest and strongest wrench ever made) you get A1 service because they are A1 quality. We do not sell "seconds," "jobbers samples" or cheap goods of any kind—every "Coes" is "Coes" quality and gives "Coes" returns.

See that the "Coes" stamp is on every wrench you buy.

COES WRENCH COMPANY

Agents: J. C. McCarty & Co.
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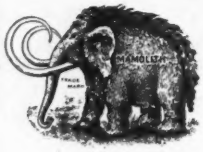
1515 Lorimer Street, Denver, Col.

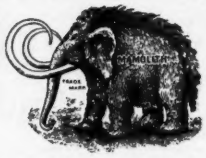
WORCESTER, MASS.

Agents: John H. Graham & Co.
113 Chambers Street, New York.
14 Thavies Inn, Holburn Circus, London, E. C.
Copenhagen, O., Denmark.

80% of the high grade wrenches made in the United States come from the Coes factories

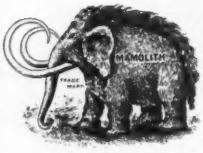


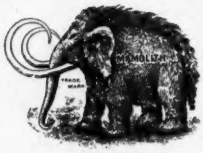
THE MAMOLITH CARBON PAINT CO.



RAILROAD AND STRUCTURAL STEEL PAINT SPECIALISTS

Water and Sun Proof coatings of Steel-like hardness, possessing that exclusive "Mamolith" elasticity.





The last word in scientific paint production.

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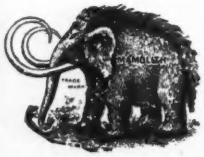
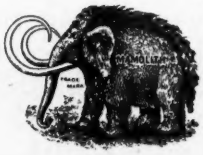


Paint Works
CINCINNATI OHIO

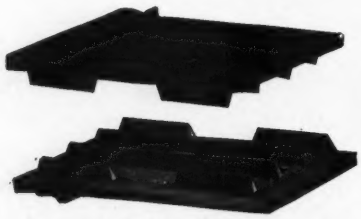
A. B. BURTIS
President and General Manager

Carbon Works
OAKLEY OHIO



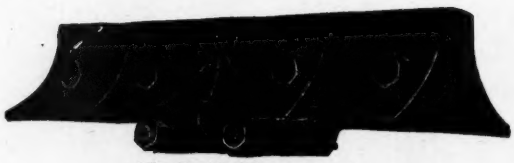
ATLAS RAIL JOINTS, TIE PLATES AND BRACES

ATLAS SWITCH STANDS AND CAR MOVERS



Top and Bottom View of Atlas Tie Plate

Atlas Primer and Surfacer for Your Cars



Atlas Standard Suspended Joint

Atlas Compromise and Insulated Joints

Made either of Atlas Special Malleable Iron or of High Grade CAST STEEL

Atlas Compromise or Step Joint
Made to Fit any Combination of Rails, Tee or Girder.

Made Either Suspended or Supported.

Atlas Insulated Joint

ATLAS RAILWAY SUPPLY COMPANY, 1523-7 Manhattan Building Phone Harrison 2900 CHICAGO

Write for Circular "M"

Section Men are Hard to Get

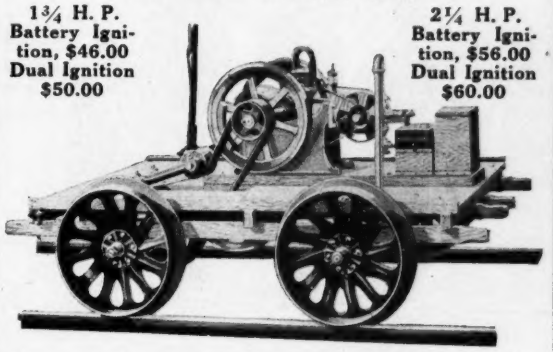
unless you use

Jerry Boy Hand Car Engines

on Your Section Cars

1¾ H. P. Battery Ignition, $46.00 Dual Ignition $50.00

2¼ H. P. Battery Ignition, $56.00 Dual Ignition $60.00



Time saved pays for them in sixty to ninety days

Safe—Reliable—Economical

Write to us for information.

Associated Manufacturers' Co.

770 Marsh-Place Building - Waterloo, Iowa

Kalamazoo Hand Cars

are equipped with the Kalamazoo Improved Reinforced Pressed Steel Wheel, giving 50 to 100 per cent greater wear than any other wheel of similar design or weight on the market. The car has stout gallows frame, thoroughly trussed, has taper wheel and pinion fits on axles, machine cut gears, flexible steady box and double acting brake.

16 Different Styles, Standard or Special

Catalogue of Track and Railway Supplies on Request

Kalamazoo Railway Supply Co.

Kalamazoo, Mich.

Western Representative: **Universal Railway Supply Co., Chicago**

TUBULAR POLES IRON OR STEEL

for Signal, Electric Railway and Lighting Service. Trolley Brackets Plain and Ornamental for Wood and Iron Poles. Line Material. Mast Arms.

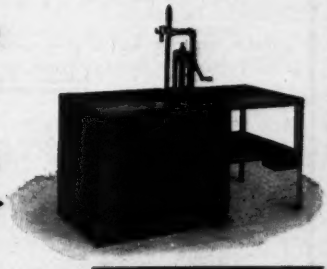
Let us estimate on your requirements

ELECTRIC RAILWAY EQUIPMENT CO.

General Office, 2900 Cormany Avenue

CINCINNATI, OHIO

Bowser Table Tank for Way Stations



It just fits the conditions at way stations or oil houses for cleaning and filling signal lamps.

The pump measures the oil into the lamp and the table catches any dirt or spilled oil. The table serves also as an ideal place for trimming and cleaning the lamps.

This is but one unit of the

Bowser Safe Storage Systems

which covers the entire oil storage field. Get our illustrated book No. 40. Free.

S. F. BOWSER & CO., Inc.

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BRANCHES

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Patentees and manufacturers of standard self-measuring hand and power driven pumps, large and small tanks, gasolene and oil storage systems, self-registering pipe line measures, oil filtration and circulating systems, dry cleaning systems, etc.

ESTABLISHED 1885. E3

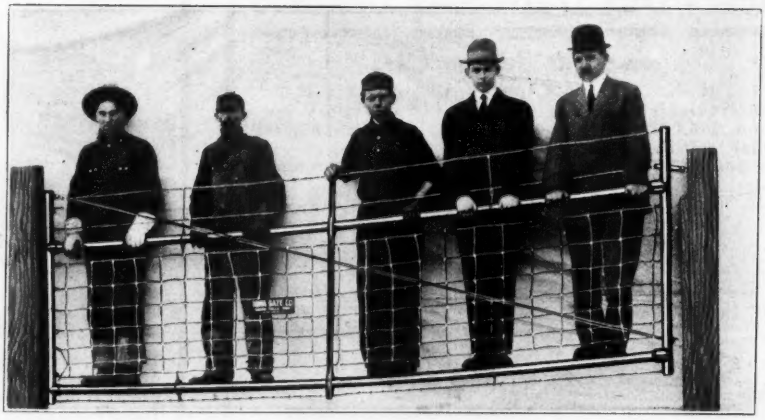
STEEL FENCE GATES

For Right of Way

$2.75

For This 10 ft. x 4 ft. Steel Fence Gate

Able to Swing Five Men and LAST You TWENTY YEARS.



Easily Handled. A swinging gate being easy to handle is, therefore, apt to be kept closed, while with a heavy board gate, the average user must, of a necessity open it to pass through. There is no such necessity compelling him to close it. And the chances are it will be left standing open. Even some steel gates have to be carried around. Style H always swings and swings clear of the ground. It is so easily handled, farmers consider it a pleasure to keep it closed and locked.

Cannot Burn or Rot. Fence men say many gates are badly damaged by catching fire from the dead burning grass along the right of way. If not burned up they are ruined for practical use. Severe winds often break the wooden gates. There is nothing about a style H fence gate to burn, blow down or rot out.

Non-Breakable. The metal frame from two-inch pipe, with steel hinges, malleable castings, steel center support and close woven hog wire, completes as nearly a non-breakable gate as can be made.

Cattle Proof. The barb wire at the top prevents stock from rubbing and abusing the gate. The two-inch reinforced pipe frame will stand twice the shock of a board gate. The close woven fabric will hold hogs back and the barb wire at the bottom keeps them from crowding under.

Hill-Side Gates. Style H fence gate can be swung up hill or down hill to fit the gate way and still swing level. This adjustment also lets the gate swing over obstructions, keeps it out of snow drifts in the winter.

Board Gates Expensive. Lumber is getting higher in price, poorer in quality and thinner in its actual dimensions every year, making steel gates an absolute necessity. A board gate never serves its purpose. Its weakness lets stock through on the right of way. Its weight and inconvenience in handling cause it to be continually left open.

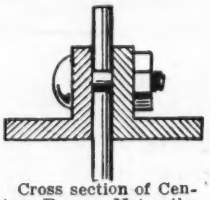
Consider our achievement in furnishing you an all steel gate, stock proof, adjustable, ready to meet any possible condition, guaranteed to give satisfactory service, and at

LESS THAN THE COST OF THE CHEAPEST BOARD GATE

DESCRIPTION

The frame is made from two-inch and two and one-quarter-inch outside diameter special tubing. Built in a rectangular shape, four corners joined by hinge couplers, permits the outer end to be adjusted a few inches or two feet if necessary. There is one extra heavy barb wire at the top and one at the bottom. The center of the frame is filled with American six-inch stay, galvanized hog fence.

Every lateral wire has a galvanized stretcher bolt. The hinges are very simple and efficient. The center of the frame is reinforced by a strut, which goes around the frame and supports the wires. The supporting cable wire is No. 8 hard drawn wire.

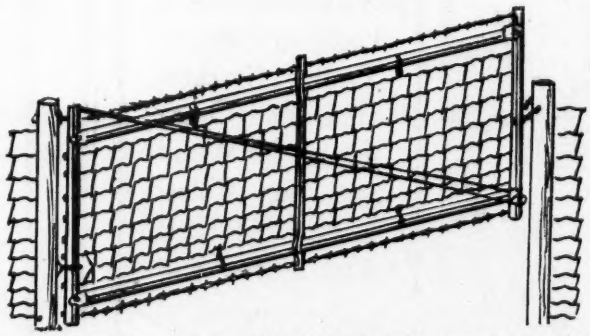


Cross section of Center Brace. Note the wires supported by it.

COUPON

TEAR ME OFF, AND PIN ME TO YOUR BUSINESS CARD. MAIL ME TO THE IOWA GATE COMPANY, CEDAR FALLS, IOWA. I WILL SEE THAT YOU GET PRICES AND INFORMATION BY RETURN MAIL.

HINGE BOLT. Five-eighths-inch round non-welded eye, 10-inch shank for the wooden posts.



Notice the outer end tilted up to swing over obstructions, to operate on the hillside, for use in winter.

This adjustment easily accomplished by changing the cable wires on the outer end. In this adjustment lies the secret of the success of this gate.

Write today and learn the secret of our remarkably low price. Ask for a list of users. Prices on any length quoted on request. Present output, 30,000 gates a year. Let us SAVE MONEY FOR YOU.

Iowa Gate Company, Railway Department, Cedar Falls, Iowa

RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

WITH WHICH IS INCORPORATED ROADMASTER AND FOREMAN

BRIDGES—BUILDINGS—CONTRACTING—SIGNALING—TRACK

Published by THE RAILWAY LIST COMPANY

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Devoted to the interests of railway engineering, maintenance of way, signaling, bridges and buildings.
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The Hyde Park Derailment.

THE report of the New York Public Service Commission on the New York Central's Twentieth Century Limited derailment at Hyde Park, N. Y., March 13, 1912, was made public some time since. The report charges the accident not to a broken rail but to a low spot in the superelevation of the outer rail on an easy curve at the point of the derailment. The report states that the broken rail was a result rather than the cause of the accident. The train was derailed while traveling at a speed variously estimated at from fifty to seventy miles per hour and four cars slid down the embankment into the Hudson River. All the pieces of the rail which was generally supposed to have caused the accident, were found. There was no visible flaw and the steel was found to conform in every respect to the standards of the New York Central.

The report finds that at the low spot the drop amounted to about one and three-eighths inches in fifty feet, at a point where the superelevation should have been four and one-eighth inches. It appears that this drop was sufficient to cause a lurch of the rolling stock against the outer rail of sufficient force to draw the inside spikes and turn it over. The report goes on to state that the inner spikes were drawn by the passage of previous trains and that the effect was cumulative. After being turned over, the rail was broken by the impact of the derailed wheels of the train. No remedy for the condition which is alleged to have caused this wreck is suggested other than a reduction of speed during winter months.

It is to be expected that tracks will get more or less out of surface, as the frost heaves the roadbed, in spite of efforts to offset the condition. There is, therefore, logic in the recommendation of the Commission that schedules of fast trains be lengthened during the winter months. The danger is not due to a uniformly high rate of speed as the schedule demands but is perhaps due in greater measure to minor delays incident to cold weather conditions and consequent efforts to make up the time. The maintenance of way department is pretty sure to receive the blame for all derailments which cannot be credited to defective rolling stocks. Its heads should therefore be careful to see that no schedules are made which do not allow a fairly large factor of safety in covering divisions where the track is susceptible to rapid changes in surface.

With reference to the case in question, however, no person of engineering education and experience can take this report of the Commission very seriously. In order to "cant" the outer rail of the curve it would have been necessary to lift the weight of the train so far as its bearing on that rail was concerned. In other words, the centrifugal force exerted would necessarily have been such as to offset half of the weight of the train. As the degree of curvature (one degree) was slight and as this curve would have been considered safe at high speeds without any elevation of the outer rail, the decision of the Commission seems most illogical.

Credit.

IN THE RAPID progress of our industrial development numbers of men are unable to keep abreast of modern methods, and the latter is especially true of those men who do not hold their minds open to conviction and adapt themselves to changing conditions.

In no field of endeavor has the progress been any more marked than in the railway field, and, in fact, it is probable that railway officials are called upon to meet conditions which are changing even more rapidly than in most any other occupation.

Expansion of business, of railway lines, and concentration of facilities has resulted in expanding the duties of some officials an enormous amount. Whereas in the past it was possible for one man to handle the large problems and most of the details of his work, it is now often the case that the man has six or a dozen assistants to relieve him of a great deal of routine work and leave him free to confine his time and attention to the most important problems which arise.

The effect on a man of such expansion of responsibilities shows with fair accuracy his breadth or narrowness. Some men who have been confronted with these conditions are still trying to take all credit for everything which is done in their offices, allowing absolutely no credit to assistants. In many cases such an attitude results in the opposite of the effect the man intends to convey. It takes but a short time for an official's subordinates to discover that they are being obscured as far as possible, and this realization tends to greatly diminish a man's zeal and efforts, besides making him antagonistic and willing to take advantage of all opportunities to slight his work. With a broad-minded superior, the man who tries to belittle his subordinates to add to his own reputation will be found out in time, and once found out he will be despised.

We firmly believe that no really capable man will hurt himself by giving all credit to his subordinates for services rendered in any given case; on the other hand, such a man will be credited with being a good organizer and an able executive. And we must all concede that the executive positions are the most important and usually carry the highest salaries.

A specific instance of two experimenters in structural work illustrates the two types of men: one made his reputation at the expense of others; a second made a high reputation, although never failing to give all deserved credit to his assistants. Both men have made reputations, but the one who never failed to credit his inferiors is the better known man to-day and he is highly respected by all members of his staff. The other man's technical reputation is secure, possibly, but his personal reputation is an unenviable one and has traveled far.

A man's promotion often depends largely on the opinion conveyed or on the recommendation of his superior, and here is where the greatest harm is done by the man greedy for personal glory. The chief engineer may have erroneous impressions of two assistant engineers of equal ability merely because one of the men has a broad-minded chief who puts in a good word for him when deserved, while the other never conveys a good impression of his subordinate.

High-Power Headlights.

SIGNAL OFFICIALS are vitally interested in the political agitation in various states which has resulted, in several instances, in laws compelling the use of headlights of high power on all railway vehicles. Where these laws have been passed and written into the statute books no provisions have been made for differences in operating conditions, but the laws are universally applicable on all railway lines in the states in question. One of the most majestically pernicious of these laws went into effect in the state of Wisconsin July 1, 1912. This law calls for headlights of sufficient power to allow of the discernment of an object the size of a man eight hundred feet away on a night of average clearness.

Tests carried out by the Wisconsin Railroad Commission proved that the only class of headlights which could conform to this stipulation was that operated by electricity. The same tests brought out the fact that this high-power light was apt to interfere with the engine crew in the interpretation of color signals. In a discussion of the situation before the Western Railway Club, October 15, it was suggested that although the color signals were sometimes read incorrectly in the beam of the high-power headlight, the positions of the semaphores could be easily noted. The discussion then logically turned to a consideration of the problems met with in the operation of high-power headlights over such lines as are equipped with color signals only; such as the "banjo" type used on certain divisions of the Chicago & North-Western. One rather impractical speaker suggested higher power lights behind the signal roundels to offset the effect of the headlight beam. Another speaker suggested that the enginemen be depended upon to switch off the electric arc of the headlight when approaching signals. Neither of these suggestions are practical or deserving of consideration.

The quality of the rays forming the beam of the electric arc has been shown to be responsible for amazing changes in the rays from opposing lights as they reach the eyes of the observer in different positions. In this regard alone, the signal engineer is interested. The other problems incident to a compliance with the state laws in question concern the operating and mechanical departments. It is interesting to note, however, that the opinions of operating men favor or do not favor the high-power headlight, as their jurisdiction covers single track lines unequipped with the automatic blocks, or multiple track lines thus equipped.

LOCOMOTIVE FUEL CONSUMPTION AND THE SPEED DIAGRAM.

Los Angeles, Oct. 8, 1912.

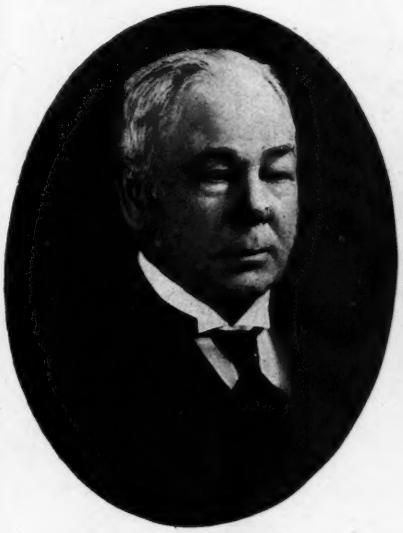
Editor *Railway Engineering*: Since the adoption of the "constant formula" for train resistance by the American Railway Engineering Association, several articles on the economics of railway operation have been published, using the formula which shows no change for corresponding speed changes. Among these, the article by A. K. Shurtleff on page 405 of the September issue of *Railway Engineering* is typical, and, like all others, leads to conclusions which are unusual. There has appeared since the adoption of the "constant formula" a most enlightening publication on train resistance which proves in a thoroughly scientific manner that train resistance varies with the speed. Professor E. C. Schmidt of the University of Illinois, in Bulletin No. 43 of the Illinois Engineering Experiment Station. gives a complete study of the subject with results obtained from many

tests made with the dynamometer car, which deserve to become the basis of any modern economic study. The committee which influenced the American Railway Engineering Association into the adoption of the "constant formula" were not in possession of this latter data, but deserve credit for the extensive investigation they made, and especially for the word of caution in which they recommended that the test records from dynamometer car tests should be used whenever they were available. This virtually adopts the results as published in the bulletin above mentioned, since it is the only one which has shown the scientific basis for the comparison of train resistance records. Mr. Shurtleff assumes that "5.4 pounds per ton is the train resistance for a car of 30.7 tons average from four to thirty-five miles per hour." In the above bulletin, on page 35, Professor Schmidt shows that a thirty-ton car will give a train resistance from 5.4 pounds per ton to 8.8 pounds per ton between those speeds. In other words, it has been thoroughly demonstrated beyond any possibility of a doubt that the resistance at 35 M. P. H. will be over 50 per cent greater than that adopted by Mr. Shurtleff in his article, and as this factor is a "multiplier" it will alter the result in a large way. The writer indicated the importance of this factor in *Railway Engineering* of June, 1911, page 224, and showed that by a mathematical correlation of the data the speed influenced the values 45 per cent and the weight of the cars influenced them 55 per cent. The contention of those favoring the "constant formula" has been that the weight was the only factor. It was the "pendulum swinging" from the old formulas in which the speed was considered the only factor. As a matter of fact, the scientific investigation shows that both are factors and hence any problems in railway economics should, recognizing this later data, be based upon a train resistance varying with the speed. J. G. VAN ZANDT.

American Railway Bridge and Building Association

ANNUAL CONVENTION.

The 22d annual convention of the American Railway Bridge and Building Association was held October 15-17 inclusive at Hotel Emerson, Baltimore, Md. The committee reports, the attendance and the interest shown in the discussion shows great progress in the work of this association.



A. E. Killam, President.

C. A. Lichty, Secretary.

J. N. Penwell, First Vice President.

Officers of the American Railway Bridge and Building Association, 1912-13.

The convention was called to order by F. E. Schall, president, who introduced Mr. Lees, secretary to the Mayor of Baltimore. Mr. Lees gave the members a hearty welcome to the city and outlined some of its interesting features.

President Schall in his opening address called attention to the increase in membership from sixty at the first convention at St. Louis to a present membership of over 500; to the fact that the association's publications had always been high class and in demand; that increasingly complex and varying conditions had always been met. He also suggested that the present officers, committee members, etc., should strive to follow out the examples of their predecessors and so make the association of increasing importance and value.

The secretary's and treasurer's reports were read and showed the association to be in excellent condition. The committee reports were then taken up.

FIREPROOFING TIMBER TRESTLES.

A progress report was submitted by Lee Jutton, chairman of the committee. Ten test structures have been erected, each ten feet long and four feet high, which are to be painted in the fall. The structure will then stand through the winter and be subjected to fire test in May or June. As a result of invitations to eighty-eight manufacturers, eighteen different brands of paint have been submitted for the test. Committee—Lee Jutton, C. & N. W., chairman; W. H. Moore, N. Y., N. H. & H.; C. A. Marcy, C. & N. W., and C. T. Musgrave, O. S. L.

Discussion.

A. S. Markley, C. & E. I.—I think that one structure should be provided for each paint tested.

C. A. Lichty, C. & N. W.—I think that the paint should be applied by some of our men, thus approximating the conditions under which the paint will be used.

C. Ettinger, I. C.—I also agree with Mr. Lichty, as I have always found it necessary in any tests to carry on the work with men who have been doing such work daily.

J. N. Penwell, L. E. & W.—I think the paint used should be bought in the open market, and samples from the manufacturers should not be used.

A. E. Killam, Intercolonial—We used to contract our painting, the paint being examined by an inspector on the ground before being used. We require a factory inspection and never allow a manufacturer to apply his own paint.

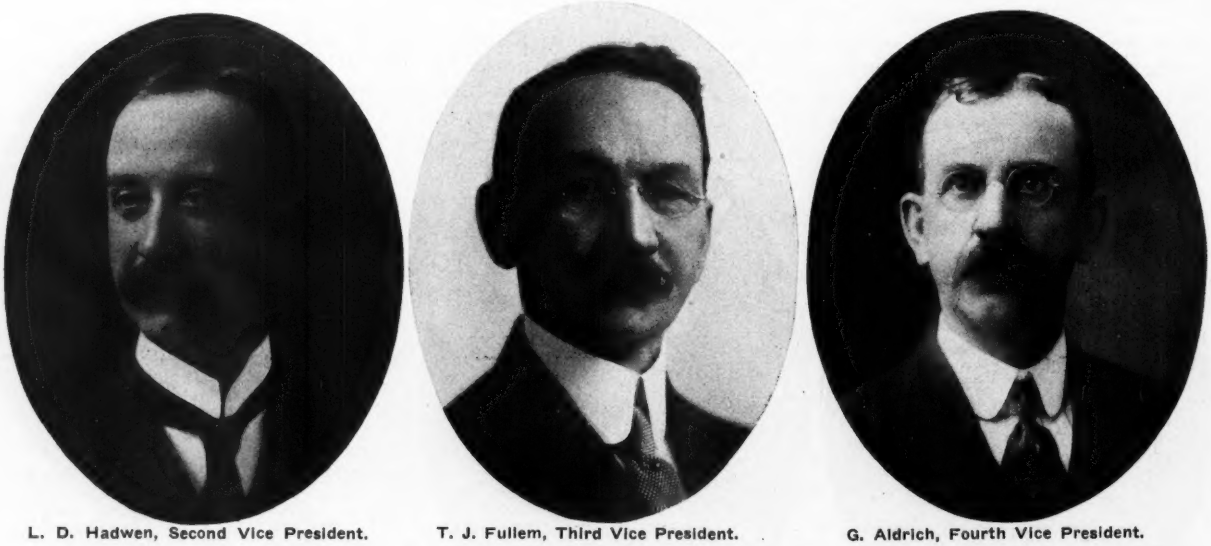
J. N. Penwell, L. E. & W.—If we have the formula of a paint we can analyze it and determine whether we are getting what we specify. If we are to test paints of which we do not know the formula, they should be bought in the open market.

Lee Jutton, C. & N. W.—Even if our samples were bought in the open market we cannot be sure the manufacturer will maintain his standards. I think we are just as safe to accept the manufacturer's samples.

A motion was passed to instruct the committee to purchase its paint in the open market and to apply it according to its own judgment.

out on the road. This committee limits its investigation to the first group. In many cases it is difficult to draw a line between the use of a derrick for the two classes of work, for a design is frequently used intermittently for both kinds of work, and its adaptability for one may govern its selection, although it may possess certain disadvantages when applied to the other work. Bridge derricks can be used to good advantage in yards when not in service on the road, but as they are very often unavailable when required for yard work, they do not fill the requirements for this purpose.

The advantages of a derrick car and the kind of car most suited for any particular work depend primarily upon the amount and kind of material to be handled. Where but a few cars of material are handled annually it is not advisable to go to much expense to install the equipment unless the proportion of heavy material is large, in which case a stationary stiff-leg derrick may be advisable. However, as the amount of material becomes greater, the advantages of a derrick increase rapidly and the committee is strongly of the opinion that derricks of some type can be used with



L. D. Hadwen, Second Vice President. T. J. Fullem, Third Vice President. G. Aldrich, Fourth Vice President.

Officers of the American Railway Bridge and Building Association, 1912-13.

LABOR SAVING APPLIANCES FOR HANDLING MATERIAL IN SUPPLY YARDS.

A circular letter was sent out by this committee and fifteen replies were received. These replies, together with thirty-one received in reply to a circular sent out last year, were classified as follows: Fifteen roads report using no derricks of any description; six roads report that the store department handles all material, shipping it directly to each piece of work; seven roads report using no derricks except steam wrecking derricks which are employed for loading heavy material; eight roads report using steam derricks of various kinds made by several prominent manufacturers which operate under their own power; six roads report using derricks of various kinds built by their own forces; one road reports the use of an electric traveling crane; two roads report using common stationary derricks similar to the stone derrick with booms of sufficient length to reach one track on each side; one road reports using an ordinary stiff-leg derrick for handling heavy material.

Derricks and other appliances for handling material are used either for supply yards or for work of various kinds

economy in a large number of yards where they are not so used to-day.

A derrick with four or five men will handle as much material as three times that number of men without such assistance, and in less time. Labor is becoming scarcer and more expensive each year. The use of proper equipment will not only reduce the number of men required, but will lighten their work and enable the foreman to secure better men for the same money. In handling heavy materials by hand the risk of injury to men is great, and this risk will increase as the foreign labor becomes more generally employed in material yards.

Another important advantage with the use of derrick cars is the greater speed in unloading matrial. This is of advantage in releasing cars more promptly, which in itself is frequently an important item in times of car shortage. The accumulation of demurrage charges can be lessened where much lumber, cement, iron pipe, etc., comes in foreign cars. This time element is of special importance in loading large quantities of material which are frequently needed for construction work, or in emergencies such as washouts and

wrecks. In such times every hour saved is very important and proper facilities and equipment for handling material will expedite work greatly.

The type of derrick to be used is largely one of individual choice and depends upon the kind of material to be handled. Where very large quantities of material are handled a traveling electric crane may be advisable. For yards of lesser importance self-propelled steam derricks with booms of sufficient length to unload material from the car in advance of the derrick on the same track, and to pile materials for some distance on either side may be advisable. A self-propelling car possesses the advantage that it can spot cars where wanted and then unload the material without requiring the attention of a switch engine, the latter usually resulting in more or less delay and being very expensive. Where a yard is not of sufficient importance to justify the expense of the above equipment, home-made derricks constructed of material on hand are frequently advisable. Derricks similar to the stone derrick with booms thirty or forty feet long are recommended where much heavy material is to be handled. Where stationary derricks are used, tramways should be built at right angles with the track to enable men to distribute lighter material out of reach of the derrick, leaving the space within reach for the storage of heavier material.

The committee has not been able to secure data relative to the cost of handling material, but from the letters received it is estimated that the cost of handling heavy timber, iron and concrete pipe, etc., can be reduced 50 per cent by the use of proper equipment. Lighter material can also be handled at a saving of from 10 to 25 per cent.

Committee—J. N. Penwell, chairman; A. S. Markley, A. Yappen, D. B. Taylor, E. A. Stanley.

Discussion.

A. S. Markley, C. & E. I.—I think large timbers can be handled with a derrick for 25c per M. A derrick only requires three men to operate it, saving sending out a large number of men. I believe a derrick can save more money than any other machine, as there are thousands of things that can be handled by it. We reduced the cost of handling timber from $2.00 or $5.00 to approximately 35c per M.

C. E. Smith, Missouri Pacific.—A small 10 or 15 ton locomotive crane with a 40-ft. boom is certainly an excellent investment.

J. M. Staten C. & O.—On our road we usually unload directly on the site of the work in small quantities, and I can see no economy in using a derrick in such a case.

A. S. Markley, C. & E. I.—We have to unload, sort and pile our timbers in yards, where we can get them in a hurry for emergencies, because they are all mixed up when we receive them.

G. W. Andrew, B. & O.—The local conditions determine the economy of the different methods of handling materials. A locomotive crane will easily save $600 a year, which is an ample charge for interest and depreciation. In addition to other uses which have been mentioned, we pick up scrap iron by rigging up an electro magnet on the end of the boom.

J. F. Parker, A., T. & S. F.—It seems to be hard to determine the most economical ways of handling material, and we should have more cost data on the subject.

CONCRETE TANK CONSTRUCTION.

In its 1911 report the committee attempted to show what had been done up to that time in this particular field of concrete construction and to determine whether or not the concrete tank was practical and could be recommended for railway service. Examples of tank built for railway and other purposes were given; specifications were quoted either wholly or in part, and it was shown that the concrete tank is practical and desirable where a permanent tank is contemplated. It is becoming more common to place the tank farther away from the tracks at railway stations and to deliver water to engine through pipe lines and stand-pipes, thereby making the water tank a more permanent structure. This decreases the necessity for a structure that can be moved on account of track changes and makes the concrete tank possible.

The two great arguments in favor of the concrete tank are permanence and minimum cost of maintenance. When the life of the tank is taken into consideration the latter will more than offset the increased cost of construction. The concrete tank is more costly than the wooden or steel tank but the steady increase in the price of lumber and the more improved methods of concrete construction are steadily reducing the difference.

The committee is of the opinion that when subjected to the severest winter weather the concrete tank will stand up better than tanks of other materials. The above statement is based on conversations with various engineers who have had experience in water supply, and at present cannot be substantiated by facts. However, some concrete tanks are located where they are subjected to severe freezing weather, and others are being considered so that it will not be long before this point can be determined definitely.

Many arguments are advanced against the concrete tank, the chief one being that poor workmanship will result in a defective tank and this cannot readily be discovered or remedied. The statement is true, but it is also true of all other forms of construction. The remedy is careful, conscientious and competent supervision in selecting materials and doing the work.

Design.

When contemplating the building of a concrete tank the design must first be decided upon. As the Association is more directly concerned in the construction work we will simply refer to the 1912 report of the American Railway Engineering Association, in which the subject of design and specification is very completely covered.

A distinct departure from the general design is a tank built quite recently in Australia. It is a hollow, inverted frustrated cone resting on a hollow cylinder or tower. The diameter of the water reservoir at the top is about twice that of the tower. While this is an odd looking structure, it has the advantage of reducing the weight on the foundation and it gives the maximum amount of water at the maximum head. This design may not appeal to most of us, and is introduced in this report because of its oddity, but it suggests the fact that it is not always necessary to confine ourselves to the old established and well beaten paths.

Material.

There is no line of work in the broad field of concrete construction in which the care and judgment used in the selection and application of the materials is of more importance than in tank construction. Only cement of approved brands should be used. It should be delivered on the job in original packages and each consignment should be carefully tested. The sand, gravel and crushed stone must be carefully examined for impurities, and all such containing impurities must be rejected. The sizes of the various materials should be carefully considered and the proportions to be used determined in order that the resulting concrete will be as dense and watertight as possible. Much has been written of this particular feature in connection with concrete work in general, therefore, it is not necessary to elaborate upon it. Our purpose is to emphasize good workmanship.

Mixture.

There seems to be a wide difference of opinion regarding the kind of a mixture that will produce the most compact and impervious concrete. Most specifications call for a wet

mixture, yet occasionally a dry mixture is specified. In regard to the latter, Mr. L. Heidenreich says in his Engineer's Pocket-Book of Reinforced Concrete. "The author prefers for tanks a rather dry mixture of one part cement to four parts coarse sand well tamped. If a wet mixture is used the mortar or concrete is apt to contract in setting, thereby causing initial compressive stresses in the steel reinforcement. When the tank is filled the concrete will crack in various places until the steel receives its tension stress. This is the common cause of leaky tanks, which must be plastered or painted afterwards." The decision as to what is best must be left to the engineer and is controlled by the material available and his past experience.

Waterproofing.

There are various methods of waterproofing concrete in use today, such as mixing a certain percentage of crude oil with the concrete or adding a paste, powder or lixiviating water to the concrete or mixing it with the cement, the mass of the concrete as a whole, or with the water. There is no doubt that any of these methods will produce an impervious concrete. However there is always a doubt whether the addition of any extraneous substance to the cement will not in time injure the concrete.

With properly graded material and careful placing of the same it is possible to get a concrete that would not require more than an application of bituminous paint on the inside to prevent any seepage of water.

Cost.

The concrete tank costs more than other tanks, but the first cost ought not to be the governing feature. A careful comparison should be made of different designs and styles of construction of tanks having the came capacity and serving the same purpose and the cost per annum in each case arrived at. The cost per annum is the average cost per year for the life of the structure.

The total cost is made up of the original cost of the structure: interest on the original cost for a period equal to the life of the structure; the total maintenance charges during the life of the structure; the interest on the maintenance charges from the time expenditures were made until the end of the life of the structure; and the risk or liability of destruction by storm or fire, whether covered by insurance or not. The total of these items divided by the number of years of life of the structure equals the cost per annum.

The building of concrete tanks is a comparatively new field and sufficient time has not elapsed since the last report to bring forth any new developments.

W. F. Strouse, assistant engineer, reports that the tank built at Sir Johns Run, W. Va.,* for the Baltimore and Ohio by the Steel Concrete Construction Co., has passed the severe winter of 1911-12 without showing any bad effacts and that only a slight sweating or seepage has appeared.

Reinforced concrete tanks were mentioned which have been installed at Chicago on the Chicago Street Railways,† at Norway, Michigan, and at Chicago Junction, O.

Committee, F. E. Weise, chairman, W. H. Finley, W. M. Clark, D. G. Musser.

Discussion.

C. E. Smith, Mo. Pac.—I find that wet concrete makes a more impervious concrete.

M. A. Long, B. & O.—The Steel Concrete Construction Co. was very confident the tank which was built for the B. & O. R. R. at Sir. Johns Run could be made watertight, and guaranteed the work. The tank at Chicago Jct., O., erected by the same company, passed an exceedingly bad winter. It was filled four days after completion, and no water drawn. The ice froze so thick and solid that chunks of concrete were torn off when the ice was removed. Such places were pointed up and washed with paint, and these patches are watertight. The average cost of these (100,000 gal.) tanks was about $7,000 each.

W. M. Clark, B. & O.—I have patched a large number of wooden tanks with concrete, with very good results.

*Described on page 420, September issue of *Railway Engineering.*

†Described on Page 420, June Issue of *Railway Engineering.*

REINFORCED CONCRETE CULVERT PIPE.

The following was submitted as a progress report:

Several roads are already adopting reinforced concrete culvert pipe for standard culverts under fills of all heights. There is no difficulty in designing reinforced concrete pipe to meet all conditions of loading, to secure sections with diameters up to 48 in. whose weight will permit handling by the same methods by which cast iron pipe is placed. Several miles of such pipe are being laid on the C. M. & St. P., this summer in connection with double tracks and change of line. Concrete pipe is used instead of cast iron as far as the available supply permits, except in the extension of existing culverts or at points where the thinner cast iron pipe is more convenient, as in replacing a timber box culvert.

Possibly, in mountainous country where pipe would be laid on steep grades, the attrition of sand bearing water at high velocities might cause trouble with this class of pipe, by gradually scouring away the invert and exposing the reinforcing. Where timber trestles are being filled and the drainage area is such as can be cared for by a pipe, generally the most economical opening to provide is a reinforced concrete pipe up to a diameter of 48 in. For openings larger than this, some form of culvert built in place will be cheaper. The question of available material and length of haul will, of course, influence the type of opening used; however, an investigation showed that on the C. M. & St. P., even with carload traffic rates, a haul of 570 miles could be incurred and still make it economical to use the concrete pipe rather than cast iron. Aside from questions of cost, a properly reinforced pipe will be more apt to fail gradually in the event of breaking under the fill than will cast iron pipe. So far, however, no failures have been reported.

There is considerable variety in the types of pipe used and in the general dimensions and manner of reinforcing.

For convenience in handling, the six foot section adopted by the C. M. & St. P., proves a desirable length and provides units of ready adaptation to various heights of fill. Sections of this length up to 48 in. in dia., are readily unloaded from cars without special appliances. The thickness of the pipe depends on the character and disposition of the reinforcement. In one type of patented pipe the reinforcement is disposed of so as to be situated in the region of tension throughout, the section being elliptical. Pipe of this kind must be placed with its major axis vertical and while permitting the use of thinner walls, it is not as convenient to handle as circular pipe which does not require a special position in service.

Recent experience of the C. R. I. & P., in using the longer 8 ft. sections on new line construction involving considerable team haul and transfer of pipe would indicate that shorter lengths are preferable. On new line work the C. M. & St. P. standard pipe was found much more convenient than the bell jointed pipe of longer section bought outside; and it was found much more costly to place the oval pipes than cylindrical ones, especial difficulty being experienced in rolling the former into place over rough and wet ground.

Most users of concrete pipe seem to adhere to the bell

and spigot joints similar to those employed with cast iron pipe. One form of the joint used is a modification of the bell and spigot, the bell having the same external diameter as the balance of the section and the wall of the spigot end being tapered, with a band locking the reinforcing of adjacent sections together, the recess occupied by the band being afterwards filled with mortar.

A pipe designed by Messrs. Graham and Andrews of the B. & O., has three pockets recessed on the outside of the pipe which permit the wiring of anchors in adjacent sections together, the pockets afterwards being filled with mortar.

In the C. M. & St. P., standard pipe, the ends are bevelled, with the portions adjusted to the outer and inner circumferences square. This results in a pipe with exterior and interior surfaces flush throughout its length when laid, insures an even bedding, and greatly simplifies the forms required, as it reduces them to plane cylindrical surfaces, the bevels being formed by cast iron rings which serve to space the interior forms. A pipe having a uniform external diameter is much easier to handle and unload from cars and can be quickly rolled off while those having enlarged bells usually are loaded vertically, bell down, and are very cumbersome to unload on a main line without special equipment.

For the smaller sizes of pipe, some form of woven wire fabric seems to be used mostly with built up cages of light bars for the larger sections. For economy in handling, some form of reinforcing that will build up a stiff cage that can be handled and set in the forms without collapsing is desirable. In building the cages for the C. M. & St. P. type, experience showed that by wiring alternate hoops to the longitudinal reinforcement in opposite directions a stiff cage resulted, while if wired in the same direction, it readily collapsed when laid on its side. The specifications do not differ materially from those required in any other highly reinforced concrete construction, a 1: 2: 4 mixture with stone of 1 in. maximum diameter prevailing.

A period of 30 days for curing before putting pipe in service seems desirable, though in summer this may be reduced to 20 days. One manufacturer writes that he had trouble with pipe which were shipped when 10 days old due to the development of fine hair cracks and that they now would not permit pipe to be shipped out until it was a month old.

Pipe can be unloaded by skidding from cars with snub lines and can be rolled down embankments with less danger of breakage than cast iron pipe. In some instances, pipe are simply dropped off the cars and allowed to roll down the banks. Methods in general are the same as those used for unloading cast iron pipe though some roads use derricks to handle the larger sizes.

Practice varies regarding filling the joints, some cementing them and others simply depending on the fit of the sections. Cementing does not appear necessary under ordinary conditions.

Little information was received in regard to the type of forms used except that steel forms were considered superior to those of wood. On the C. M. & St. P., wooden forms were used when the manufacture was first started, but these are being discarded as they wear out, and are replaced by steel forms of the company's own design, which are proving very satisfactory. About one year's steady service was found to be all that could be gotten out of wooden forms and the steel forms are much more economical.

There is practical unanimity regarding the saving effected by the use of concrete pipe in place of cast iron, the relative cost depending on local conditions, but being from 25 to 50 per cent less. The economy is more marked with increase in diameter.

With cast iron at $28.00 per ton, and the market quotations for manufactured concrete pipe, the following shows the relative cost per lin. ft., for the two kinds:

	24 in.	30 in.	36 in.	48 in.
Cast Iron	$2.23	$3.33	$4.66	$8.26
Concrete	2.00	2.80	3.15	4.50

Very few railways have had concrete pipe in use many years. The Wabash has had pipe in service for five years and no failures have been observed, here or elsewhere where the pipe have been properly handled and placed.

Committee, L. D. Hadwen, chairman, H. H. Decker, R. O. Elliott, F. O. Draper, F. E. King, G. Loughnane.

Discussion.

C. E. Smith, Mo. Pac.—I think the costs given for concrete pipe are too low.

F. Lee, C. P. Ry.—Concrete pipe is heavy and more expensive to handle, but it is cheaper than cast iron and necessitates little expense for maintenance.

G. W. Andrews, B. & O.—We have made 36-inch concrete pipe at $1.79 per ft. on one section of our road. On another the cost was $1.80 per ft., and it is much cheaper than iron pipe.

F. Lee, C. P. Ry.—Above 48-inch diameter we estimate a culvert to be cheaper than concrete pipe.

A. E. Killan, Intercolonial.—Our concrete pipe sections are interlocked and have concrete abutments at the ends, and never pull apart. In soft fills we use a layer of concrete under the pipe.

A. S. Markley, C. & E. I.—We have concrete pipe installed in 1888, so there is no doubt about the durability if properly made.

C. E. Smith, Mo. Pac.—A concentration of load on a 3-ft. length of concrete pipe is much more serious than on a 12-ft. pipe, and I think a foundation is necessary for concrete pipe.

BUILT UP ROOFINGS.

No written report was submitted by the committee. J. N. Penwell, chairman, stated that results were proving that the 1911 report was being held up by the experience of the members.

CONSTRUCTION AND MAINTENANCE OF LONG PIPE LINES.

It is usually the case that water impounded for gravity supply has to be carried a long distance to the point of use through pipe lines. If such is the case, the ground for the pipe line should be carefully gone over and a survey made to endeavor to locate the line on an even grade without going into depressions or over rises. Where this is not possible air valves must be placed at all high points in the line to allow the air to escape, as the air will always rise to the highest point and if not allowed to escape will retard the flow of water and eventually stop it altogether, until the air is released. There are many air valves on the market and care should be exercised in the selection of the proper kind so that the attention necessary to keep in condition will be greatly reduced and less failure will occur in the water supply.

The selection of the pipe best suited for the pipe line depends largely on the nature of the soil. This must be considered with respect to its chemical composition so as to provide the proper kind of pipe to withstand the corrosive action of the soil in which it is to be laid, some soil being so bad that it is necessary to use wooden pipes, which are used successfully for a great many years while in the same soil iron pipe will last but a very short time. A paint or dip put on the pipe will prevent corrosion for a great many years in some soils if properly applied. Asphalt dip is one of the best and when put on properly will keep the soil from getting at the body of the pipe for years. A satisfactory

method is to dip the pipe in asphalt at the proper temperature, the pipe also being heated. After the first coat roll the pipe in sawdust and when hardened dip again. In this way a coat of asphalt over ⅛ in. thick will be taken on which will withstand the action of the soil for a long time.

A tee with a plug or a valve looking down should be placed in pipe lines leading from reservoirs at intervals along the line so that the line can be opened and the accumulation of foreign matter that may be in the pipe may be flushed out. If sediment is allowed to remain it will gradually decrease the carrying capacity of the pipe line to a very considerable extent and lines have been known to fill up entirely from an accumulation of silt in a few years.

The expansion of long pipe lines has to be taken into consideration and the regular expansion joint of about six inches transverse should be placed according to the varying temperature of the locality. Pipe lines should be placed underground at a sufficient depth to protect them from the action of frost or extreme varying temperature.

In the construction of a pipe line the first thing to be done is to prepare the ditch properly. The ditch should be dug to such a depth that the pipe will be below the frost-line when covered. This depth will vary according to the climate where the line is located. The trench must be level, or even on the bottom, so that the pipe will be firmly on the ground, otherwise it will settle, and cause leakage. This precaution is especially necessary when laying wooden pipe which should be driven firmly together, but care must be used to see that the joints are not forced too hard, as this tends to split the tenons away from the pipe. When back-filling, the utmost care should be used in tamping around and under the pipe so that no settling will take place, otherwise the pipe will settle both out of line and out of round.

Mr. J. L. Campbell, engineer in charge, on the Bento Pipe Line, El Paso & Southwestern, found by investigation, that wood pipe under a pressure of 130 lbs. would give satisfactory service for 25 years, on which basis it was less expensive than cast iron and was therefore used. Cast iron was considered preferable to steel for pressures not exceeding 310 lbs. on account of its greater durability.

Committee, B. J. Mustain, chairman; E. S. Hume, D. Burke, E. R. Floren, W. C. Dale.

Discussion.

C. R. Knowles, I. C.—We have considerable wood stave pipe which has caused us large maintenance expense. When hollow log pipes were used the timber left was all sap wood, fairly uniform in structure. Stave pipe is made of both heart and sap and is not uniform in structure, and does not give such good results.

A. H. King, O. S. L.—We use wood pipe in damp places, where the wood is saturated practically all the time, and in such places it lasts well.

H. Taylor, D. & R. G.—We have had heavy maintenance expense with our wood pipe lines.

J. Ewart, B. & M.—We are having much trouble with electrolysis with iron and steel pipes, and have not found a remedy for this destructive agent. Wrought iron is more expensive, but it lasts much longer and it is certainly worth the extra cost.

A. E. Killam, Intercolonial.—Our pipe lines are short, and cast iron lasts indefinitely. We had some home made wooden pipe which lasted 12 years without a leak, and at that time use of the pipe was discontinued, though still in good condition.

E. F. Robinson, C. & N. W.—The soil a metal pipe is covered with affects very materially the life of the pipe. We had a pipe line covered with cinders which was completely pitted and had to be removed in six years. The new pipe was covered with blue clay, has been in use for 13 years, and is in excellent condition. Some kinds of sand also hasten corrosion.

James Dupree, C. T. H. & S. E.—We need a clay covering or a waterproof roof of some kind over pipe lines. We have found galvanized pipe, if properly laid, lasts very well, although we know the iron which is galvanized is usually of a poorer quality.

The question of intakes was discussed, several ideas being given for preventing the suction of dirt, etc., into the pipes; among these were a plank box with the top a little below water, the intake pipe opening from the bottom of the box; a stopper valve was described which is closed when no water is being drawn.

C. R. Knowles.—We use twin strainers to keep sediment out of intake water; one strainer can be closed while the other is in use. This is a very satisfactory method.

DEVELOPMENT OF TURNTABLES.

Standard Lengths.

Practically all roads report short tables in service on old lines, but no road reported a standard length shorter than 75 ft. The standard lengths reported by various roads are as follows: 12 roads, 75 ft.; 19 roads, 80 ft.; 13 roads, 85 ft.; 10 roads, 90 ft.; 2 roads, 100 ft.

In addition several of the roads report the use of turntables longer than the standard for special purposes such as the turning of Mallet locomotives, the elimination of frogs in approach tracks, etc. The longest table reported in use is on the C. M. & P. S., and is a pony truss table 105 ft. long, weighing 175,000 lbs.

The necessity for a liberal allowance for future increase in length is shown by past experience. For some reason turntables have invariably been built only long enough for engines actually in use and frequent enlargement has been necessary. In this connection the Santa Fe reports: "In 1896 we commenced building 60 ft. tables. We used these about two years and then went to 75 ft. The 75 ft. length lasted less than one year when the new engines forced us up to 85 ft. tables."

The Committee feels that the deck type of table is preferable to any other type on account of its low first cost, ease of operation and economy of maintenance but sees no serious objections to through tables where conditions demand their use.

Where through girders are used the best practice seems to favor providing supports for the ties by means of steel stringers and floor beams instead of using deep ties resting on shelf angles. The deep ties are expensive in first cost and in maintenance, and promote corrosion of the girder webs and shelf angles. The steel cross girders at the center of the turntable require a depth at least as great as a standard floor system so the depth of pit need not be increased for the floor system.

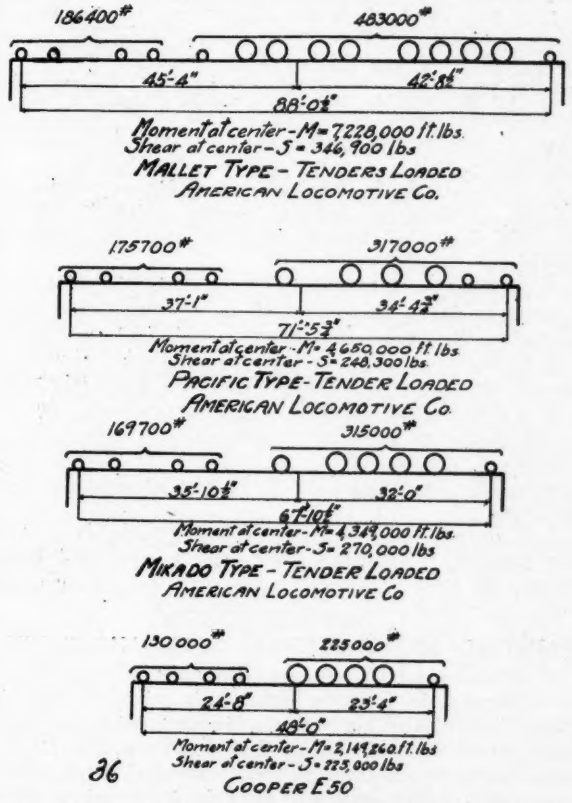
The depth of pit for the shorter tables will probably never be sufficient to compel the use of short through tables, say less than 75 ft. The advantage of using through tables for the greater lengths is indicated by the pit for the Pennsylvania 100 ft. deck turntable in which the depth from base of rail to top of catch basin is 11 ft. 2 in., while for the Norfolk and Western 100 ft. through turntable the depth is only 7 ft. 6 in.

Where through girders are used they should not be placed less than 15 ft. between centers as with a closer spacing the danger arises of men getting caught between an engine and the girder flanges.

Turntables should be so designed that the deflection of the ends will not be so great as to cause both ends to drag while turning heavy engines, and it should not be necessary to place the rails on the table too high above the approach

rails to accomplish this as that will result in too great a drop of the ends when an engine reaches the end of the table. In general the rails on the table should not be more than ¾ in. above the approach rails and should come down level while engines are passing on or off.

Although a bridge designed for Cooper's E-50 or other Cooper's loading will support without any increase in stress over that used in the design actual modern engines considerably heavier than the Cooper's loading (on account of the longer wheelbase of the modern engines distributing the load over a greater length of bridge) the same engine on a turntable will cause the stresses that affect the deflection



Bending Moment at Centers of Turntables Loaded with Different Types of Locomotives.

of the ends to very materially exceed those used in this design, for the reason that the longer wheelbase increases the negative bending moment on a turntable. This is well illustrated in the diagram comparing the effect and appearance of Cooper's E-50 loading to modern heavy Mikado, Pacific and Mallet type engines which causes stresses in bridges approximately equal to those caused by Cooper's E-50.

The unit stresses should be chosen low enough to keep the deflection down to a minimum, 10,000 lbs. per sq. in. for tension and the equivalent for compression, and 6,000 lbs. per sq. in. for shear being reasonable values. With these stresses it is not necessary to add any allowance for impact except at the ends where live load stresses in all parts subject to pounding should be increased 100 per cent to provide for impact.

The drainage of turntable pits, which has always been very important, becomes a much larger problem for the longer tables and deeper pits. Many engineers have had experience with pits that flooded during heavy rains or from flood water backing up through the drains.

Although tables can be operated under such conditions, the results are very bad, particularly on account of the damage to the center. In addition the water in the pit sometimes freezes and stops operation. After floods it is frequently necessary to take the center apart for cleaning and oiling with consequent delays to locomotives. While such delays might not seriously inconvenience operation at an outlying point where few engines are turned, they cannot be tolerated at busy terminals where it is of the greatest importance that the turntables be maintained in continuous service.

In former years when shorter tables were used the depth of the pit was not great and drainage could easily be secured without serious trouble or the accumulation of water would not be deep enough to cause trouble.

In case the lowest point of the engine house drainage is lower than the bottom of the turntable pit, the drainage of the pit can be made secondary to that of the engine house.

In any case the most efficient, economical and satisfactory drainage is provided by catch basins and gravity drains where the highest water in the outlet is lower than the bottom of the pit. Where this condition does not obtain the problem of drainage can be simplified in several ways, some of which are as follows:

Use of trough type of table, thereby decreasing the depth of pit.

Use of shallow, non-tipping tables, that is, tables that rest on three or more points while turning.

Use of waterproof pits, with sumps and pumping.

All railroads replying to the circular sent out by the Committee uniformly report the use of concrete foundations and the necessity of great care in construction of the center foundation. The great majority reported bases 12 ft. sq. on 16 piles. Footings as large as 16 ft. sq. with 49 piles were reported. Many roads reinforce the top or bottom of the center concrete or both. The cap, especially on old foundations, is frequently of stone. When installing new tables on old foundations requiring a change in elevation of the top of the center it is quite customary to cast a reinforced concrete capstone of proper thickness, which when properly hardened is substituted for the old capstone during the changing of the tables.

Many cases were reported of the settlement of centers having been stopped by excavating a trench around the footing, extending down two or three ft. deeper than the old footing, and underpinning the old foundation as well as extending the base by filling the trench with concrete, piles being driven where necessary.

Electric power where available has the preference on practically all roads. Turning by air motors appears to have the next preference for outlying points where tables are not much used and where current cannot be obtained and where trouble with air motors, necessitating turning the table by hand, will not be serious. Gasoline engines are recommended for turning tables where electric current cannot be obtained and where liability of freezing renders the use of air motors objectionable.

Non-tipping Tables.

A short time ago there was considerable talk of having special non-tipping turntables, that is, the tables that would rest at all times at both ends and the center and in case of long tables, at intermediate points, which turntables would be quite similar in design to the present transfer tables. This practice has not developed to any remarkable extent, however, but some roads are using a modification in providing heavy end carriages and motors on balancing turntables, so that for the shorter engines the turning can be performed in the regular way with the least work and for the longer engines balancing is not necessary as the motors are powerful enough to pull the loaded end truck around the circle.

The Committee recommends providing a support for the ends of the approach rails on creosoted coping timbers, not

less than 12 in. wide at the narrowest point, and preferably 8 in. thick, with two heavy standard tie plates under the end of each rail, where the rails are spaced so as to permit this, or a special plate not less than one in. thick, 12 in. wide and long enough to pass under the two near rails of adjacent tracks, the plates to be drilled for track spikes or screw spikes and for lag screws for attaching them to the coping timber. The coping timber should be attached to the concrete by anchor bolts.

The Committee also recommends providing support for the circle rail by short creosoted ties about 15 in. center to center under main tracks and 24 in. elsewhere, with tie plates and screw spikes where available. To hold these ties in position and to prevent the accumulation of dirt, cinders, rubbish, etc., the space between them and between their outer ends and the parapet wall should be filled with concrete sloped to drain under the circle rail to the pit.

The center is the heart of a turntable. When that is out of business the turntable is out of service. The difference in cost between a very poor center and the very best center is so slight compared to the importance of avoiding trouble that the best centers available should be used.

Forty-six roads reported the use of manufacturers' standards of conical roller bearing centers, some with ball bearings or phosphor bronse discs at the ends of the rollers to reduce friction, and others depending on the cast top and bottom sections holding theirs in position. A number of roads design their own centers.

The oiling of the moving parts of the center whether rollers, balls or discs is very important. The bottom casting should be so designed that the rollers, discs or balls can move in a path of oil, and the top casting so designed that cinders, dirt or other grit can not get inside. A mixture of black oil and signal oil is excellent for the lubrication of centers. They should be flushed out frequently by kerosene or gasoline, and should be taken apart and cleaned whenever they begin to turn hard.

While the Committee does not feel itself justified in recommending disc centers, in the face of the extended use of the roller bearing centers, which in many cases are satisfactory, it does recommend that properly designed disc centers be given serious consideration.

About 50 roads report that frogs are not used in their standard lay-outs, but are used in special cases where new tables are installed in old lay-outs. About ten roads report using frogs in their standard lay-outs, usually for the purpose of getting more stalls in a complete circle. The Committee recommends that the use of frogs in approach tracks be avoided where possible to avoid them and that standard lay-outs be prepared with that object in view.

The maintenance of turntables may be easy or hard according to conditions. If proper care is used in the design and construction, the maintenance should not be difficult although it will necessitate frequent inspection and immediate correction of any defects that may be discovered. Constant war must be waged against the elements that tend to corrode the table and the Committee knows no other means of preventing corrosion than frequent cleaning and painting, patch painting when necessary. At least once each year and as much oftener as centers are submerged by floods or turn hard for any reason, the table should be jacked up and the center thoroughly cleaned and re-filled with oil. To facilitate this jacking many roads provide steel brackets riveted to the table and concrete foundation for the jacks on one diameter of the pit.

Committee, C. E. Smith, chairman; C. H. Fake, F. G. Jonah, J. S. Berry, A. S. Markley.

Discussion.

B. F. Pickering, B. B. & M.—We have had a lot of trouble with disc centers, using gasoline motors. It required 10 to 15 men to turn the tables when motor was not working. We reduced the number of discs, and increased the sizes, and the turntables have been working fine, two men now being able to turn same with large engine on them.

C. E. Smith, Mo. Pac.—Properly designed disc centers are all right if not overloaded. A railway will take a turntable designed by a manufacturer without asking any question, but would not think of accepting a bridge under such conditions.

W. E. Alexander, B. & O.—Disc centers work very hard if the table gets tipped a little, as it frequently does in winter. We do not have the same trouble with roller centers, which we substituted for the discs.

J. N. Penwell, L. E. & W.—A circle rail set directly on concrete is unsatisfactory. The concrete wears and water freezes under the rail heaving it out of surface.

B. F. Pickering, B. B. & M.—We have had trouble with ice forming behind the circle rail, and forcing it in. We have no trouble with bearing on ties bolted down to the concrete.

H. C. Swartz, G. T.—We lay a steam pipe around the pit next to the circle rail, and also lay one around the center. We keep these pipes hot enough to prevent any trouble on account of freezing water.

A. H. King, O. S. L.—We had trouble with the turntables without carriages, on account of not spotting the engines carefully. We placed carriages at one end of all such tables.

J. B. Sheldon, N. Y. N. H. & H.—We have a center on one of our turntables which was placed in service in 1870, and is still giving satisfaction. The center is as large or larger than some being made today. Its success, I think, was due to the large rolls and large number of them, and also because the center lines of the rolls are always on radial lines.

J. N. Penwell, L. E. & W.—I think it is profitable to pave pit bottoms, as it makes them easy to clean and helps protect the table.

PAINTING OF STRUCTURAL IRON AND STEEL.

Scientific research and numerous practical tests have demonstrated the fact that certain paint pigments, though possessing excellent moisture repelling properties, will actually stimulate corrosion when applied directly to steel surfaces, while certain other pigments have a tendency to restrict and repress corrosion when used for primers and foundation coats. Because of this we divide the pigments into rust retarding, and air and moisture excluding ones, using the first for priming and contact coats, and the latter, for finishing and exposed surface purposes. The pigments used in steel protective paints of the first kind are principally red lead, oxides and the like, while carbons, lamp blacks, graphite, etc., belong in the other class.

Shop Coating.

A rust retarding coat may be suitably compounded from red lead mixed with pure linseed oil. The average stock mixture may consist of from 25 to 30 lbs. of red lead to the gallon of oil. This mixture can then be reduced to the proper consistency at the time of application. A small amount of turpentine added to this brush coating will greatly help in its manipulation and will also provide for proper penetration. Red lead should always be mixed at the time of its application for it settles quite readily, as it is an extremely heavy pigment. If so desired, the settling can be retarded, to a certain degree, by the addition of a small amount of asbestine (magnesium silicate) in the proportion of about 20 lbs. of red lead and 2½ to 3 lbs. of asbestine pulp to the gallon of linseed oil. A small amount of turpentine should also be added to this mixture for the purpose mentioned above. A good workman is required to properly

apply red paint because of its more or less difficult application.

Natural oxides have also proven to be very good for priming purposes, and very satisfactory results are recorded from their use. A number of consumers favor oxides because of their easier application and the less expert class of labor which is required to apply it. A saving of from five to ten per cent, as compared with red lead paint, can be effected. Some concerns are using a combination of red lead and oxide and make good reports regarding it. A number of reliable paint firms have similarly composed products on the market, which are sold under certain trade names, and some concerns have adopted them as their standards.

Although quite extensively used in former years, linseed oil is rapidly losing favor. It appears to be a universal opinion that linseed oil is not a desirable material for the prime coating of metals when used without the addition of pigments. A foundation coat of linseed oil is very often the direct cause of peeling and blistering of the other several coatings applied over it. The oil is seldom dried enough to insure close adherence to the metal surface which it covers, before the other paints are spread over it. When the subsequent coats of paint are spread, the solvents and oils in them are bound to soften to some extent the underlying coat of oil, and the moderate heat of the sun alone is sufficient to cause the whole film to draw up, blister, and finally peel. Too much oil in a paint coating, particularly when the surplus is in or near the foundation coat, will generally cause blistering and peeling, regardless of the pigments used in the coatings. If on the other hand, the erection or final completion of an oil coated structure should, for some reason become delayed, this oil film which deteriorates much faster than a paint coating, will have practically perished, its surface will be morbid and dead and will not have strength and stability enough to carry any subsequent coats, which when applied over this kind of a surface, will also peel.

Field Coatings.

Paints containing the same kinds of pigments as for shop coating, can be successfully used for the first field coat, providing it is covered with another elastic outer coating. If that is not done, paints suitable for finishing coats should be applied, and the first field coat omitted. Red lead or oxide priming should be darkened for this coat by adding carbon or lamp black in the proportion of 90 to 95 per cent of the reds and 5 to 10 per cent of carbon mixed. The addition of this black will not only help to make the coating more elastic, but will act as a guide to determine if the former surface is being completely covered because of its darker shade and the shade is also brought nearer to the color of the black finish coating.

Carbon lamp black, and graphite pigments, singly or mixtures of them, have given best satisfaction as outer surface and finishing paints. These, combined with some inert and reinforcing pigments, from special formulas, form the basis for nearly every brand of satisfactory metal coatings on the market. The addition of some high grade gum-like "Kauri" improves a finishing paint greatly, producing more elasticity, resistance and life. It is of course just as essential that the oils entering into the makeup and composition of the various paints are of the proper kind and quality, as that the selection and composition of pigments be properly made and storekeepers or other officers charged with the duties of passing on the merits of goods purchased should be very alert and strict in regard to linseed oil. Paints containing tar or those with a tar base, should not be used on steel structures exposed to the sun and weather, as tar paint films rapidly check, crack and "alligator."

Repainting.

When for any reason it becomes necessary to repaint an iron or steel structure, the paint should never be applied in wet or freezing weather, and the surface should be freed absolutely from all scales, rust, dirt, etc. It is not sufficient to merely apply a fresh coat of paint over an old paint surface under which traces of paint corrosion appear, for while the new paint will cover up the old surface, and may adhere firmly to it, corrosion goes on beneath the paint just the same. Freeing from rust and corrosion and perfect cleaning are positively necessary. When it is not possible that the entire structure can receive a coat of some rust-retarding primer, the parts cleaned and freed from rust, and all the exposed surfaces, at least, should be touched up with either a red lead or oxide primer, before the finishing coat is given. The use of turpentine in the paint applied over the old surface, is advised, as turpentine is a penetrant, providing the penetration and adhesion between the old paint film and the new coat.

Although more expensive cleaning by sand blast is much more thorough than the hammer, chisel, scraper and wire brush method, the greater cost is readily offset by better results in the end. The sand blast method thus far has not been very extensively used, so the committee has not been able to gather full data as to the cost, etc., but we believe that the matter is worthy of deliberate consideration. Where the sand blast has been used and the steel has been painted promptly it has not shown signs of corrosion again nearly as quickly as steel cleaned by hand.

Occasionally we notice defects showing up here and there on a steel structure within an unusually short time after the completion of the painting. On looking into the matter we find that nothing extraordinary has occurred during the progress of the work. Everything has been handled in the usual way, the general course of mechanical procedure has been followed, and still improper results are appearing. We recall no acts of our own to which to lay the blame and are finally compelled to look for the cause previous to our own handling of the work, or to the priming which was done at the works or in the mill.

Committee, Chas. Ettinger, chairman; R. H. Reid, E. E. Wilson, O. F. Barnes, O. F. Dalstrom.

Discussion.

C. Ettinger, I. C.—The reason lamp black is very durable is that it absorbs 35 per cent more oil than other paints.

A. E. Killam, Intercolonial.—We tried sand blasting with a Fairbanks Morse & Co. sand blast, but it did not completely clean the structure.

C. Ettinger, I. C.—I have seen a high pressure sand blast cut out scales ⅛ in. thick.

B. F. Pickering, B. B. & M.—Local conditions greatly affect the durability of paint, dampness having a greater effect than change in temperatures. I find structures on the coast require much more frequent painting than those in the hills.

BRICK AND CONCRETE IN BUILDINGS AND PLATFORMS.

Passenger and Combination Passenger and Freight Stations.

Either brick or concrete may be used with satisfactory results in the construction of passenger stations. Brick has been in successful use for many years while the use of concrete has been steadily growing for several years. For foundations of all kinds concrete is superior to all other kinds of material as it is cheaper and stronger. By the use of reinforced concrete the bearing area may be increased when necessary without great additional expense. For walls above foundations there is not much difference in cost between plain concrete and good brick construction for

the ordinary sizes of station buildings, costing up to $15,000 or $20,000. For one story buildings of this size and where not more than one building of the same size and shape is likely to be erected in any one season on the same division there is little opportunity to effect any economy by using the forms over again.

Where variety of design is desired this can be effected by a combination of brick and concrete in the walls, using concrete for the frame, columns, etc., and brick for the walls, pilasters and general decorative treatment. There will be little if any excess cost in this type of construction and very pleasing results may be obtained. Several railroads have used this type of construction to a limited extent with good results. Care must be taken to maintain good proportions by not allowing too much exposed concrete and to make a judicious selection of colors to obtain pleasing and harmonious results. The building must likewise be adapted to its environments to give complete satisfaction.

Buildings having solid monolithic concrete walls are harder to heat in cold weather than if built of brick, even though air space is provided by furring on the inside. Special precautions must be taken to secure good ventilation to avoid dampness, for in wet weather concrete absorbs a great deal of moisture which gives the structure a rather disagreeable appearance. A great deal of dirt will accumulate on the outside walls at such times and much permanent discoloration results. In dry climates this objection does not exist to as great an extent and for this reason as well as from the fact that the natural color of concrete harmonizes with the landscape in dry countries, concrete gives better satisfaction in such climates.

Monolithic walls can be constructed with air spaces and insulation in the walls so that dampness may be kept out and less difficulty is experienced in keeping the rooms warm, but such construction is expensive and not in general use. It could not be recommended for buildings of this type.

Another type of construction that has given good results is the continuation of the concrete wall above the foundation up to the height of the window sills and the use of brick above. This much of the wall is generally plain and is not cut by openings other than doors, so that it needs no ornamentation or finish. It can be constructed comparatively cheaply and should be placed at the same time that the foundation is placed. This can be recommended as good practice.

The unit construction system or the process of casting walls in sections in moulds laid on the ground and afterwards placing the sections in position by means of a derrick is being developed. It is especially suited to one story structures of large area and of such nature that the walls can be designed to consist of a number of bays of the same size. This method has not as yet been adopted for structures of the size and type of passenger stations, and does not appear to have any advantages for ordinary construction of this type.

On the Wabash Railroad small passenger stations have been constructed in which the walls are built of solid concrete to the bottom of the windows and of frame with cement stucco finish above this. This type has been reported as giving good satisfaction in this class of buildings. Owing to the lightness of the super walls the concrete above the foundation is only nine inches thick. The cost of such a building does not greatly exceed that of wooden buildings having equally good foundations and other features to correspond.

Concrete blocks properly made can be used to advantage in buildings of medium size. When walls of one thickness of blocks are laid up, the cost is a little less than the cost of brick. The cost of buildings of this sort will be about 30 cents per superficial foot when blocks 8 in. thick are used. There are limitations, however, to this type of construction and to be most economical the building must be designed so that all dimensions shall be multiples of the size of the blocks used. This type of construction can be carried on in cold weather as well as brick work. Plain blocks having flat surfaces give more pleasing results artistically than blocks moulded in imitation of stone. Concrete blocks cannot be made to look like stone and any attempt to do so results unfavorably. Concrete blocks are subject to discoloration the same as monolithic work and from the standpoint of appearance brick work is superior. Otherwise there is not much choice between the two for use in moderate sized plain structures.

For use in larger buildings the cost of which exceeds $50,000, splendid results have been obtained by the use of concrete throughout the entire construction. The Lake Shore and Baltimore & Ohio depot at Gary, Ind., is an example of such construction. Such results as were here obtained could not have been secured had brick been used. In this particular, concrete passes beyond the field of brick and enters the realm of stone as a building material. This example should stand as an encouragement to the use of monolitic concrete in less pretentious structures.

From the standpoint of safety there is no difference between the two classes of material for use in the walls of passenger stations provided perfect workmanship is exacted in both cases. There is greater danger at the present time of defects in concrete than in brick walls due to lack of experience on the part of the workman, so that when concrete is used thorough inspection must be maintained and the work entrusted only to foremen who understand thoroughly the nature of concrete and how it should be handled. Many of the poor results obtained where concrete has been used are attributable to improper handling of the materials. Owing to the fact that concrete construction has not been carried on long enough, foremen and workmen thoroughly competent to handle it are scarce, while not so much difficulty is encountered in securing competent bricklayers. This condition, however, should not act as a deterrent against the persistent adaptation of concrete to all its possible uses, but should incite caution in the minds of those who contemplate new departures in its use and should impress upon them the necessity of a thorough understanding of all the principles involved in the work to guard against disaster.

From the standpoint of comparative durability there is no choice between concrete and good brick. Concrete in itself would undoubtedly outlive brick in large masses, yet owing to the numerous other factors that determine the life of a building of this sort either material will answer equally well.

The comparative fire resisting qualities of concrete and such brick as may be used in building work is somewhat a matter of conjecture and depends upon the character of the fire. If a building has wooden floors, ceiling and roof timbers, a fire originating on the inside would completely destroy the building in either event. If the building is practically of fireproof construction throughout, a fire such as might occur in the ticket office furniture would not damage either materially. Either type would act equally well as a fire retardent from fires originating outside of the building. Slight fires might be liable to cause the surface of the cement to scale off, whereas brick would not be damaged at all.

Concrete work is not subject to extensive alteration and where alteration is a possible factor of importance brick is preferable.

Considerable has been said about the qualities each of

these materials has that lend themselves to architectural treatment. There is no material superior to good brick for use in securing plain, durable and dignified effects. The proper arrangement of brick to give a good appearance to a building need add no expense to the construction. The beauty of many brick stations has been destroyed or seriously marred by the erection of ungainly platforms around the building proper and it is needless to add that if the surroundings of a building are not made harmonious with the structure itself, any effort bestowed upon the building will be fruitless. Brick possesses the advantage of many fine colors that lend themselves to varied treatment. Generally speaking the darker and softer colors are most readily adapted to most situations and are never injured seriously by the smoke and dirt that are unavoidable about railway stations. The lighter colored bricks likewise give good results when properly chosen. They seem to be best suited to plain treatment in larger buildings when good straight line effects may be had.

Concrete takes its beauty from its appearance of strength and solidity. Its architectural treatment should be confined to plain surfaces, straight lines and arched effects over doors, windows, etc. Paneling can be used to advantage in some places. Where covered platforms are necessary much better effects can be secured if the sheds are supported on concrete columns arched over to support the roof, so that they have the appearance of a continuous part of the building. If concrete is used, care must be taken to avoid placing any ironwork in such position that rust can be carried therefrom over the surface of the concrete by rain, for discoloration will result.

No attempt should be made to add elaborate details such as ornamental friezes, cornices or capitals to small or medium sized stations. This style of ornamentation adds materially to the cost of the structure and does not improve the appearance. Ornamentation of this character is effective only in larger buildings where massive column effects and other features of this nature can be secured in good relative proportions.

Freight Stations and Warehouses.

For freight stations and warehouses many of the principles applying in passenger stations are found. There is one essential difference, however, in the fact that the buildings are usually larger. Here again brick has been in successful use for many years. The latitude for using concrete, however, is wider than in passenger stations. For foundations concrete is preferable in all cases. For one story buildings reinforced concrete can be used with advantage in columns and girders, while thin curtain walls of brick or cement plaster on metal lath are especially suitable. The unit form of construction is well adapted to this class of structure.

The chairman of your committee would call attention to a concrete warehouse of the Universal Portland Cement Company located on Elston avenue just north of North avenue, in Chicago, that was built in this manner. The particular advantages of this type of construction are that the units can be cast in moulds at less expense than in forms erected in place.

If the sections are allowed to harden and cure thoroughly as they should be before being erected there will be no possibility of their cracking as might occur if the concrete is poured in place. The units are securely fastened together when erected. Although requiring a somewhat different equipment, the method of erection involves practically the same operation and costs the same as elevating the wet concrete to pour it in forms erected in place. The fact that the entire side of the mould is open allows more careful placing of the concrete and reinforcement in the thinner portions of the walls.

If it is desired to use concrete floors and roof construction, the columns, frame, pilasters, beams, etc., should also be constructed of concrete. The curtain walls may be either of brick, hollow tile, reinforced concrete, or concrete plaster on metal lath. The latter, however, could scarcely be recommended in buildings when all other parts are of heavy concrete construction as the saving in curtain walls would be a doubtful economy. If wooden floors and roof construction are used, there is little choice between brick or concrete for the walls.

Engine Houses.

The factors that determine the choice of materials for engine house construction are the same in some respects as they are in other buildings. The experience of most roads has been that their engine houses have been outgrown and have had to be replaced on account of inadequacy to meet conditions rather than on account of decrepitude, so that while this condition may not continue to be true of the future to so marked an extent, yet the factor of durability of material is secondary to first cost.

Considerable progress has been made in the construction of engine houses entirely of concrete. When it is desired to go to the expense of making the house essentially fireproof by making the roof, girders and posts of concrete and by using metal sash and fixtures, as much as possible, then without doubt the balance of the construction should be of concrete. Some objection has been raised to concrete being used in the outer wall on account of the damage that may be done if an engine should accidentally run through. This need not be considered except that the wall should be so constructed that if this should happen the damage would be confined wholly to the curtain wall and would not extend to the pilasters or beams supporting the roof. If this is done, no greater and probably not as great damage will be done as would occur in a house having brick in ordinary construction in the outer walls. Where concrete is used, more opportunity is given for window spaces in the outer wall. As a matter of fact, the entire space between pilasters down to the level of the tracks has been and may readily be utilized for this purpose, as the roof support can be carried above the windows from pilaster to pilaster by means of beams. This form of construction gives room also for considerable economy in the foundation concrete between pilasters. Care must be exercised in designing houses of this kind to properly proportion the foundation to withstand the jarring action of the locomotives passing in and out of the house. The foundations and pits for all classes of construction should undoubtedly be of concrete.

If the interior and roof construction are to be of timber the outer walls above the foundation or at least above the bottom of the windows can be built of sufficient strength more economically of common brick than they can be of concrete. It will be advisable from the standpoint of safety to construct fire walls in houses of this type of more than 15 stalls. These can be built more economically of hollow tile although brick is generally used. When the construction is fireproof throughout fire walls may be omitted, although they will be of advantage in the warming of houses, especially if they are heated by the hot air system. It is needless to state that greater economy in the use of concrete can be effected in the largest houses admitting of using the form lumber several times.

Shops.

Reinforced concrete is particularly well adapted for use in the construction of shop and power house buildings. Either plain or reinforced concrete should be used throughout for foundations, both for the building proper and for the machinery. If the most durable fireproof buildings are desired reinforced concrete should be used throughout the entire

construction. A peculiar advantage possessed by this type of construction lies in the freedom from vibration caused by machinery. In one story buildings, especially, curtain walls may be constructed of cement plaster that will answer the purpose as well as solid construction and at less cost. Here also the unit construction method can be followed to advantage as buildings of this class will naturally be designed in bays of identical proportions.

Hollow concrete blocks have also been used to advantage in shop and power house construction. The air spaces in the blocks serve the very useful purpose of keeping out moisture and retaining the warmth, and thus overcome to a great extent two of the most objectionable features of solid concrete in building construction. For buildings of any great size the blocks should be larger than the ordinary blocks and of heavier proportions throughout. The design of the building will determine the proper dimensions, but for walls 25 ft. or more in height the blocks should be at least 12 in. thick. Monolithic foundations should be used and also either monolithic pilasters should be adopted or solid blocks used to properly carry the load at points where girders and beams are supported. If the blocks are made on the job they can be cast solid. Where some ornamentation is desired window sills, lintels, copings, arches, etc., can be cast solid in moulds with good effect and the walls may be bush hammered. This adds to the cost, of course, but may not be inconsistent. The circumstances in each case and the effect desired should govern the treatment. The Committee considers it proper to recommend that attention should be paid to appearance and proper treatment given in each structure built no matter for what purpose to secure a dignified harmonious aspect, but it does not recommend any "gingerbread" work.

It is our opinion that in the matter of cost of buildings of this class that the outer walls can be built cheaper of common building brick costing from $6 to $8 per thousand and that the use of brick is safer if we consider the possibility of danger from poor workmanship. By the use of concrete foundation, brick walls and cement tile roofs, supported by steel trusses, results as satisfactory as could be desired can be had.

For floors in such buildings neither brick nor concrete has proven entirely satsifactory. Creosoted wooden blocks on a concrete base are being tried and seem to be proving satisfactory. In some cases second hand bridge timbers have been cut up and used on a sand or cinder base. These give good satisfaction while new, but do not last as long as could be desired. Mr. Riney, foreman of bridges and buildings of the C. & N. W., who has had a lifetime of experience in this work, recommends wooden blocks on a concrete foundation with a sand cushion between as the most satisfactory type of floor in shops and engine houses.

Interlocking Towers.

For interlocking towers either concrete or brick may be used to good advantage. For this class of buildings the most economical construction seems to be the use of solid columns at the corners and light curtain walls between. Concrete is well adapted to this purpose although brick may be used in the same manner. The importance of fire-proofing interlocking towers is a strong factor in their construction and is receiving more attention than formerly.

Oil Houses, Toolhouses, Etc.

Buildings of this class can be constructed of either material. For the smaller sizes cement plaster is recommended as preferable to either brick or concrete. Its cost is less and its answers every purpose equally as well as the most expensive solid construction. Cement blocks of the ordinary building size have been used and while good results are obtained, they are more expensive than necessary. For larger oil houses and store houses such as are ordinarily required at important division headquarters, heavier construction is necessary and should be either of brick or reinforced concrete. The floors, foundations and roof should be of concrete, while there is no choice between the two materials for the walls.

Other Buildings.

In the construction of office buildings, grain elevators, docks and other structures no general rule can be applied. Concrete is coming into favor for use in the construction of elevators and docks. Brick has never been used to any great extent in either of these cases. All kinds of materials have been used for office buildings but brick is still preferable. There is nothing peculiar about a railroad office building that would differentiate it from any other office building and local conditions and practice will govern largely in the selection of material.

Cinder Pits and Turntable Foundations.

For this class of structures concrete is preferable under ordinary circumstances. Cinder pits should be paved with a good fire resisting brick. Brick will not only withstand the effect of hot cinders and the water used to quench the fire for a longer time, but may also be renewed when it gives out. Cinder concrete has been recommended as not subject to so great disintegration as stone or gravel concrete when subjected to these conditions, but it is the opinion of the Committee that the safer method is to pave the pit with brick. Whether or not the sidewalls should be lined with brick depends upon how severely they are likely to be heated. This will depend upon the size of the pit, and upon whether or not the cinders can be removed before they pile up against the walls. Brick for the entire construction of cinder pits could not be recommended.

Turntable walls and center piers should not be built of brick. Concrete is suitable for this construction. If the pit is to be paved it may be done either with brick or concrete. One feature of turntable construction to be considered is that in the past it has been frequently necessary to replace tables that have become too short before their full life is secured, thus necessitating the construction of new circle walls. If this is anticipated concrete should not be used. In this event it would be better to build the wall of rubble masonry.

Platforms and Walks.

For walks the accepted practice where the walks are used almost exclusively if not wholly by pedestrians is a five or six inch cement concrete on a cinder base constructed in accordance with ordinary sidewalk specifications.

For platforms there seems to be a great diversity of opinion. The two principal objections to concrete are that when wet it is slippery and consequently more or less dangerous and that when cracked by frost, falling baggage or other causes it is difficult to repair.

One objection to brick is that a brick platform is likely to become uneven and may cause passengers to stumble and in this way be dangerous. Another is that it is harder to truck over on account of its greater resistence to traction and is more likely to shake baggage off the trucks.

There are three general types in general use in the construction of what may be called permanent platforms.

1st. Vitrified brick on a gravel or cinder base. This base should not be less than 6 in. thick and should be as much as 12 in. under some conditions. Platforms of this type can be built for nine cents per sq. ft. exclusive of curb. Either timber or concrete curb may be used, although concrete is preferable. This type can be recommended for way stations where there are not more than ten trains per day and at suburban stations where a comparatively small amount of baggage is handled.

2nd. Cement platforms 5 to 6 in. thick on cinder filling 6 in or more in depth. Such platforms cost 13 cents per sq.

ft. To make these safe they should be finished with a wooden float and not troweled. Such platforms will not become slippery even when wet. The greater danger will be experienced when the platform is covered with a light snowfall or heavy frost, but these conditions will make any platform more or less slipery. Concrete curbs should be provided adjacent to the tracks and driveways but they are not necessary elsewhere. Such platforms will serve for all classes of stations.

3rd. Vitrified brick on a concrete base. This type of platform requires a curb and will cost about 16 cents per sq. ft. It can be recommended only at very busy stations where a great amount of trucking is going on.

None of these types should be used, except on thoroughly settled foundations if it can be avoided. On new embankments some temporary construction should be used if possible. If absolutely necessary to have some better sort of platform the first type is preferable, on account of the fact that the brick may be removed and uneven places leveled up. All these classes require the same drainage provisions. For large terminals concrete platforms covered with asphalt are used. The cost of the concrete, of course, varies with the depth. The asphalt coating applied about 1½ in. thick will cost 20-25 cents per sq. ft. It provides a good wearing surface but should not be subjected to any more severe trucking than can be avoided. Rubber tired truck wheels should be used. It is, of course, possible to mix the mastic so that it will be hard enough to stand severe trucking, but if it is desired to secure a resilient surface for walking on it should be understood that the consistency most favorable for this purpose will not admit of very hard trucking.

Freight platforms can be built most advantageously of concrete. They may be elevated to any height desired. The side supports should be carried down below the level of the ground and safe foundations provided. The interior space should be filled with earth or gravel thoroughly compacted. Most roads, however, still use timber construction; it is cheaper for elevated platforms, especially, and can be renewed from time to time at less expense where second hand bridge timber is available for the purpose. Elevated concrete platforms cost from $.80 to $1.00 per sq. ft.

For miscellaneous platforms for use in coach cleaning yards, etc., where permanent construction is desired concrete is best. These platforms are constructed the same as sidewalks.

Committee—Geo. W. Hand, chairman, H. A. Horning, G. H. Jennings, Peter Hofecker, W. F. Strouse, E. M. Dolan, D. G. Musser, P. E. Schneider.

Discussion.

E. F. Robinson, C. & N. W.—I find that brick is more satisfactory than concrete for buildings.

M. A. Long, B. & O.—Furring must be used on inside of concrete walls to prevent sweating. An entire concrete building costs more than brick.

E. F. Robinson, C. & N. W.—Brick platforms, with the brick laid flatwise, I find more satisfactory than concrete platforms. The latter crack, and cannot be taken up and relaid as brick platforms can.

COMMITTEE SUBJECTS ASSIGNED, ELECTION OF OFFICERS AND OTHER BUSINESS.

The subjects assigned for committees for next year were as follows: Water Supply; Track Scales (continued); Concrete Culverts and Various Kinds of Pipe Culverts; Heating and Ventilating Roundhouses and Shops; Sewers and Drains; Motor Cars for Bridge and Building Gangs; Temporary Structures for Supporting Track While Carrying on Sewer Work, Etc.; Concrete Posts, Poles, Signs, Etc.; Preservation of Timber; Framing on the Job, Etc.; Recent Development of Cattle Guards.

The following officers were elected: President, A. E. Killam, Intercolonial; first vice-president, J. N. Penwell, L. E. & W.; second vice-president, L. D. Hadwen, C., M. & St. P., third vice-president, T. J. Fullem, I. C.; fourth vice-president, G. Aldrich, N. Y., N. H. & H.; secretary, C. A. Lichty, C. & N. W.; treasurer, J. P. Canty, B. & M.

A number of entertainment features were provided by the Supply Association. Tuesday evening an informal luncheon was tendered members and guests. An excellent musical program was furnished and enjoyed by all. The lady visitors at the convention were given a number of inspection and pleasure trips about Baltimore.

The members were taken on an inspection trip of the B. & O. terminal on Thursday. Lunch was served in two buffet cars attached to the special train provided.

Montreal was selected as the location for next year's meeting.

New Books

FREIGHT TERMINALS AND TRAINS. By John A. Droege; 5¾x9; cloth, 465 pages. Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Price $5.00.

This book is in a sense a revision of "Yards and Terminals" published in 1906 by the Railway Age Gazette. The treatment of the subject, however, is a considerably broader one. The work is a very complete and exhaustive treatise on the entire subject of rail freight transportation in the United States and Canada and it includes, probably for purposes of comparison, a short description of English methods. Problems of the operating department are of course given prominence. Engineering department officers, however, will be interested in the author's discussion of yard and terminal layouts; and officers of the mechanical department find their work touched upon in the chapters on engine houses, coaling stations, and on the duties of the engine house foreman. The author has added masterful touches to the book through the assistance of Chas. B. Breed, associate professor of civil engineering in the Massachusetts Institute of Technology, who wrote a chapter on "Track and Maintenance Details;" and that of Wm. J. Cunningham, assistant professor of transportation, of Harvard University, who wrote a chapter on "British Freight Service." There are few students of railway transportation or, indeed, experienced railway officers who will not find this book of very considerable assistance. It seems to supply information which has long been needed in just this form.

The Union Pacific is planning to build a new freight house at Kansas City, Mo., a duplicate of its present freight house, at a cost of $45,000. It will be of steel and concrete construction.

The Santa Fe, according to press reports, is having plans prepared for new shops and other improvements to be built at Albuquerque, N. M., at an approximate cost of $1,600,000.

Work has been started by the Grand Trunk on the reconstruction of its bridge over the Grand river at Brantford, Ont., at a cost of about $40,000. A span of 76 ft. 6 in. will be added to the western end of the present structure, and the eastern end will be lengthened 15 ft.

The Canadian Pacific, it is said, has completed plans for a stone depot to be built at Coquitlam, B. C.

A reinforced concrete coaling station has recently been installed by the Baltimore & Ohio at Warwick, Ohio, designed for coaling locomotives on four tracks. The new coaling station is of the Holmen type, with a storage capacity of 600 tons, and a conveying capacity of 100 tons an hour.

BLACK ROCK HARBOR SWING SPAN, G. T. RY.

R. D. Garner, Assistant Engineer.

After costing the lives of four men while building, the great steel swing span of the international bridge over the government's new $5,000,000 ship canal at Black Rock, N. Y., was swung into place on July 2, 1911.

This is one of the longest and heaviest single span bridges on the continent, being 431 ft. 5 in. long, 29 ft. wide, with a clearance of 22 ft. 6 in. above the water line. It provides for the operation of trains over a double track, and for electric cars and pedestrian traffic. The bridge weighs 4,500,000 lbs. and was erected at a cost of $500,000. It is used by five trunk lines and after navigation closes handles an average of 300 trains per day.

The bridge across the old channel was comparatively new, but had a clearance in width of but 80 ft. As no other right of way could be secured it was necessary to place a new bridge at the same point as the old one. This problem was worked out by Mr. H. G. Kelley, vice-president of the Grand Trunk, assisted by E. W. See and R. D. Garner. The electrical engineer was J. H. Burnett. The general contract for the power plant was awarded the Otto Gas Engine Works of Philadelphia.

The work was accomplished without blocking trains (which run on an average of eight minutes) or boats, until the actual operation of tearing out the old span and swinging in the new one was begun. This work started at 10 A. M., July 2, and the first train ran over the new bridge just five hours later.

The bridge is operated by electricity and can be swung in 70 seconds. The two turning motors are of the Westinghouse street car type, each rated at 53 H. P. and guaranteed to develop 100 per cent overload for a short time. In addition there are two end lift motors of 15 H. P. each and two smaller motors of 5 H. P. each to operate the rail wedges. A small air compressor supplies power for operating the end lock and band brakes. All are controlled from the operator's house above the deck of the bridge. By use of contactors which are controlled by sliding contacts connected between the end mechanism, rail wedges, and drum of the bridge, it is impossible for the operator to go wrong in opening the bridge. The current for the end lift motors can only be had after the rail wedges have been drawn. Likewise the current for the turning motors cannot be had until the ends have been raised. In closing, the above operation is reversed.

To supply the current for the bridge a power house was erected at a cost of $25,000. To make sure there will always be power available for turning the bridge the following apparatus has been installed: 1 255-cell Gould storage battery having a capacity of 60 amperes at the 8-hour rate; one 100 H. P. Otto gas engine direct connected to a Garwood generator 60 KW. commutating pole; one Garwood generator set of 60 KW., direct connected to a 2,200-volt induction motor driven by Niagara Falls power.

This is one of the first installations in which commutating poles have been used. The generators are further wound to operate as compound wound machines at a voltage of 500 to 550 volts and as shunt wound machines at 750 volts. A short circuiting switch is provided for cutting out the series.

The switchboard was furnished by Robertson-Cateract Co., Buffalo, N. Y. One of the men about the yards visits the station at certain periods and from the instrument on the board ascertains whether or not it is necessary to replenish the supply of electricity in the storage batteries.

It is possible to form any combination, that is to run both generators direct to the bridge, or charge the storage battery with one generator and operate the bridge with the other or operate bridge from storage battery, or if it should for any reason be necessary, to parallel both generator and storage battery, thus giving an output of over 400 H. P. for a limited time. One man starts the engine with perfect ease. It is equipped with automatic and force feed oiling system.

The following tests have been made to show the power required by the bridge and its cost. The surprising result is that the gas engine set operates for less than half of what the Niagara Falls power costs.

Power Required on the Bridge.

For lighting navigation lights; operator's house and deck of bridge: 17 16 c. p. lamps burning 12 hours per day; 102 amp. hrs. or 52.02 KW. hours.

For signal lights, half of which burn at once and then only when bridge is swung: 16 8 c. p. lamps; assume ten swings per day of ten minutes duration. This gives 3.32 amp. hrs. or 1.69 KW. hours. Time of operation, 4 seconds.

Volts, 510. Withdrawal of rail wedges, current required: 10 amps., 0.011 amp. hrs. or 0.0056 KW. hours. Time of operation, 40 seconds. Volts, 510.

Inserting rail wedges: Current required, 10 amps., 0.011 amp. hrs. or 0.056 KW. hours.

Number of wedges: (2) Total current required for both wedges for each swing, 0.044 amp. hrs., 0.224 KW. hours. For ten swings 0.44 amp. hrs. or 2.24 KW. hours.

For Operating End Lifts of Bridge.

Raising: Time of operation, 8 seconds. Volts, 510. Current required, 15 amps., 0.033 amp. hrs. or 0.0168 KW. hours.

Lowering: Time of operation, 8 seconds. Volts, 510. Current required, 15 amps., 0.033 amp. hrs. or 0.0168 KW. hours.

Number of end lifts: (2) Total current required by both end lifts for each swing 0.132 amp. hrs. or 0.0672 KW. hours. For ten swings 1.32 amp. hrs. or 0.672 KW. hours.

Air Compressor.

Used to operate latch, whistle and band brakes. Motor cuts in automatically when pressure falls to 75 lbs. and cuts out at 100 lbs, runs about three minutes for each swing. Requires 15 amps. at 510 volts.

For each swing, 0.75 amp. hrs. or 0.382 KW. hours.
For ten swings, 7.50 amp. hrs. or 3.820 KW. hours.

Turning the Bridge.

Time of operation 60 seconds. Volts, 500.

Opening: Average current for readings taken 5 seconds apart was 80 amps., 1.328 amp. hrs. or 0.664 KW. hrs.

Closing: Same readings as above. Total current per swing 2.656 amp. hrs. or 1.328 KW. hrs. Total current per swing 26.56 amp. hrs. or 13.28 KW. hrs.

Total Current Used on Bridge for All Purposes for One Day Assuming Ten Swings:

	KW. Hrs.	Amp. Hrs.
For rail wedges	2.240	.44
For end lifts	.672	1.32
For turning	13.280	26.56
For lights	53.710	105.32
For compressor	3.820	7.50
Total	73.722	141.14

Total Current Required on Bridge per Swing (No Lighting).

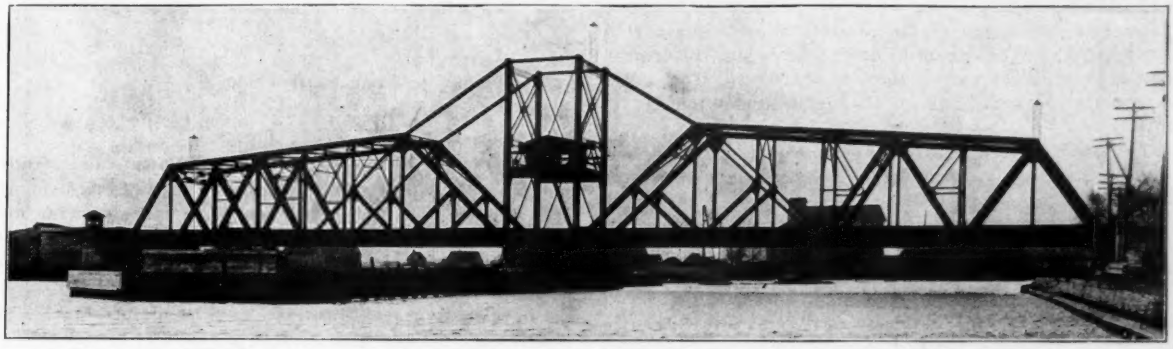
	KW. Hrs.
For rail wedges	.224
For end lifts	.0672
For turning	1.3280
For compressor	.3825
For signals	.1690
	2.1707

All of the above readings are the average of a number of

careful tests made on Sept. 3, 1911. Velocity of wind, 4 miles per hour.

Cost of Generating Current With the Gas Engine Set.

Otto gas engine No. 14341, 100 H. P. Speed, 190 r. p. m.
Single cylinder horizontal type.
Direct connected to Garwood generator No. 15759.
500 to 600 V. Amp. 86.
Date of test, Aug. 25, 1911. Gas meter reading, 911906.
Kind of load, charging battery. Rate of charge, 60 amp.
Voltage variation during run, 545 to 660 volts.



Black Rock Harbor Swing Span.

Average voltage taken from recording voltmeter, 602.
Gas meter reading at end of run, 914514. Gas used, 2608 cu. ft.

Total cost of gas at 30 cts. per 1,000 equals	$0.782
Total KW. hrs. generated equals 108.35.	
Cost for labor, 8 hrs. at 30 cts. per hour gives	0.90
Cost for oil, ½ gal., at 40 cts. per gal	0.20
Cost for water at 2c per 1,000	0.12
Total	$2.102

Cost per KW. hr. equals $0.0184.

Assuming a loss of 15 per cent in the battery, then the cost of power for the bridge per month, using the gas engine and assuming 10 swings per day, would be as follows:

Actual power required by bridge, 2,211.66 KW. hrs.
Actual power given to battery, 2,601.96 KW. hrs.
Then 2,601.96 KW. hrs. at $0.0184 gives $47.87 per month.

Cost of Power Using the Niagara Current.

Current supplied from Falls at 2,200 volts, 25 cycle and 3 phase.

Motor generator set consists of the following:

Crocker-Wheeler Co. A. C. induction motor No. 96362. 100 H. P. at 750 R. P. M., 24 amp., 25 cycle, 2200 V., 3 phase.

Garwood generator type C. & C. L., 60 KW., 600 to 700 V., 86 amp., speed 720.

Date of test, Aug. 31, 1911. Service meter reading, 5,034 KW. hr.

Kind of load charging battery. Rate of charge, 60 amp.

Voltage variation, 545 to 645 volts.

Average voltage taken from recording voltmeter chart, 600.

Length of run, 2 hours.

Service meter reading at end of run, 5,122.

Total KW. hrs. used, 88.

Best rates to be had for this power are as follows:

Fixed charges of $50.00 per month for service.

Additional charge by meter.

For 1,000 units or less per month, $0.02 per unit.

For excess over 1,000 up to 2,000, $0.015 per unit.

For excess over 2,000 up to 3,000, $0.012 per unit.

For excess over 3,000 up to 4,000, $0.010 per uint

The actual number of KW. hrs. used by the bridge per month is only 2,211.66. Assume a loss of 30 per cent in changing from the Falls power to D. C. and storing in battery. Then the maximum demand on the service meter would be 3,159.51 KW. hrs. At $0.012 per KW. hr. the cost of current for the above test would be $1.056. One engineer for 2 hrs. gives $0.60. Amount of oil used per hour, about one-half cent.

This gives a total of $1.666.

Since the generator gave only 72 KW. hrs. to battery, then cost per KW. equals $0.023.

Assume a loss of 15 per cent in battery, then cost of power for the bridge per month using the Niagara Falls service would be as follows:

2601.96 KW. hrs. at $0.023 per KW. hr. gives $59.84
To this must be added the charge for service 50.00

Total $109.84

	Per month	
Interest on investment for motor generator set (5 per cent interest)	$ 15.00	
Cost for power	109.84	
Total	$124.84	$124.84
Interest on investment for gas engine unit (5 per cent interest)	$ 27.00	
Cost for power	47.87	$ 74.87
Total	$ 74.87	$ 49.97

Thus there is a saving of $49.97 per month by using the gas engine set.

The Missouri, Kansas & Texas will reinforce bridges on its main line between Hillboro, Tex., and Houston. The work will cost about $30,000.

The New York Central and the New York, New Haven & Hartford, it is stated, will build a union station at Pittsfield, Mass. Estimated cost $500,000.

The New York, New Haven & Hartford, it is reported, will spend about $225,000 in the elimination of grade crossings in Providence, R. I.

The Great Northern has awarded the contract for the construction of a brick and concrete freight depot at Great Falls, Mont., to C. O. Jarl, of Great Falls, at a contract price of $60,000.

The Manufacturers' Ry. of St. Louis, Mo., has given a contract, it is said, to the G. Hartman Construction Co., St. Louis, Mo., for the erection of an engine house and machine shop for locomotive repairs on the water front in St. Louis. The cost will be about $70,000. Joseph Tumalty Plumbing Co. has the plumbing contract, A. F. Pollman the excavation, and the erecting of steel work will be done by Christopher Simpson Iron Co.

The Missouri & North Arkansas has plans for the construction and equipment of shops at Eureka Springs, Ark; the cost, with mechanical equipment, will be about $150,000.

The Virginia & Carolina is said to have plans well along for building its extension through East Tennessee and to Willesboro, N. C.

Industrial Notes

The General Electric Co. has elected W. D. Matthews, a director of the Canadian Pacific Railway Company, as vice-president, to fill the vacancy caused by the death of H. P. Dwight.

William H. Corbin, vice-president of The Joseph Dixon Crucible Company, Jersey City, N. J., died on Wednesday, September 25.

The International Steel Co., Seattle, Wash., is reported incorporated in Washington to erect a large steel plant near Seattle, Wash. The capital stock is $20,000,000. The incorporators are Otto B. Ruff, J. B. Joujon-Roche and W. T. Dovell.

The National Railway Safety Appliance Co., it is said, will establish a factory to manufacture railway safety devices at Biloxi, Miss.

A United States Government order for 85,000 lbs. of boiler compound has been awarded to the Geo. W. Lord Co., of Philadelphia, Pa.

E. H. Briggs has been appointed salesman for S. F. Bowser & Co. in the Southwest territory. Mr. Briggs is well qualified for the position, having been connected with railway business for a number of years.

F. B. Marble, who resigned recently as assistant chief engineer of the Michigan Central, has been appointed superintendent of construction for the Siems-Carey Company, Ltd., railway contractors, with headquarters at Mile 53, B. C.

The name of Northey-Plummer, Ltd., has been changed to Northey-Simmen Signal Company, Ltd. This company makes and installs the Simmen system of railway signals.

C. A. Carscadin has been appointed general sales agent of the Spencer Otis Co., with offices in the Railway Exchange building, Chicago, Ill. Mr. Carscadin was formerly with the Kirby Equipment Co., of Chicago.

The Dukesmith Air Brake Co. was chartered in Dover, Del., on October 23. It is capitalized at $1,000,000, the incorporators being William H. Geib, Pittsburgh, Pa., and Elmer E. Stewart, of Castle Shannon.

The following board of directors was elected at the annual meeting of the stockholders of the Carbon Steel Company, New York: Charles McKnight, Gilbert G. Thorne, Edward C. Hoyt, George S. Macrum, Edward F. Slayback, D. E. Corbett, and Thomas Patterson. The board of directors elected the following officers: President, Charles McKnight; vice-president, Gilbert G. Thorne; second vice-president, George S. Macrum; treasurer, James Thorne; and secretary, D. E. Corbett.

A "Builders Permanent Exposition" has been opened in the Karpen Bldg., 900 So. Michigan Ave., Chicago. It occupies the entire second floor—approximately 25,000 square feet—and is devoted to the display and marketing of building materials and supplies. The spaces are of various sizes and renters are supplied with heat, light, janitor service, telephone and telegraph service, together with committee rooms and reading rooms. The permanent exhibit of railway supplies and equipment is also located in this building.

The Santa Fe has bought 30 acres of land on the Oakland, Cal., estuary, to be used for freight terminal facilities.

The Atlantic Coast Line, it is reported, will rebuild the depot at Camilla, Ga., recently destroyed by fire.

The Baltimore & Ohio will erect a steel bridge across the South branch of the Potomac river at Green Spring on the Cumberland division. The contract has been awarded. The Pennsylvania Steel Co. will erect the steel work and the Smith, McCormick Co., of Easton, Pa., has been awarded the contract for the masonry and substructure. The cost of the bridge completed will approximate $100,000 and the weight of the structure will be about 1,500,000 lbs.

New Literature

The Vulcan Engineering Sales Co., 30 Church St., New York, has issued two circulars describing and illustrating Pneumatic Hoists, Traveling Cranes and Jib Cranes. Six types of Pneumatic hoists are illustrated and described in one of the circulars. Illustrations and descriptions are also given of a double sheave and yoke, and a single sheave and yoke used with several of the hoists. A large number of jib cranes are illustrated and described, from light hand to heavy electric hoists. Trolleys for heavy cranes are shown to fit all types of crane construction.

* * * *

Cook's Standard Tool Co., Kalamazoo, Mich., has recently incorporated a number of new features in the Cook bonding drill described in a new booklet. The improvements are mainly in the absolute and rapid control of the direction of the movement of the bit. The direction the bit moves is changed instantly by pressing a lever with the left hand, the handle being always turned in the same direction. The drill is exceptionally easy to place on and take off the rail.

* * * *

The MacArthur Concrete Pile & Foundation Co., of 11 Pine Street, New York City, has recently published a new edition of its book, "The Pedestal Pile." The general layout of the book is the same as that of the first edition, but it contains a number of illustrations and descriptions of work recently completed and also other additions to the text. The book contains much valuable data on the bearing power of soils, frictional resistance, etc., besides a complete description of the Pedestal Pile and how it is constructed, and should prove of interest to engineers and architects.

* * * *

The C. H. & E. Mfg. Co., 321 Mineral St., Milwaukee, Wis., has issued literature describing a trench pump which is meeting with considerable approval from users. The pump is driven by a gasoline engine, and the circular states it will easily do the work of four men, and the apparatus never gets out of order. The outfit is mounted on a heavy skid, or if desired, on a wagon with wide rimmed wheels.

* * * *

The 1912 catalogue issued by the Ramapo Iron Works, 30 Church St., New York, contains a large number of diagrams of standard track work manufactured by that company, which have not appeared in previous issues. Many of these designs are shown in both manganese and reinforced construction, all of which have been tried out in actual service. The catalogue states in the preface, "It is not practical to illustrate everything we manufacture, in a catalogue of convenient size. Our principal designs and approved standards are shown, as representative of our various lines of work, but we are prepared to furnish blue prints, illustrating special designs in detail, such as guarded and housed switches, street railway curves, car house layouts, special forgings, etc."

* * * *

The Buda Company, Chicago, Ill., has issued a very complete set of specifications under which its No. 19 Buda Section Motor Car is made. These specifications give very complete and detailed information as to the manufacture and quality of the material used. They also describe very clearly the operation of the special drive, with points of advantage.

THE Engineer's Distress

DRAFTSMANS EDITION

DRAFTSMENS TROUBLES ARE MANY SO WHATS THE USE.

A LIGHT ITALIAN OPERA WRITTEN FOR M of W. OFFICE SOMEWHERE ON A WESTERN LINE

CHARACTERS

DIVISUN ENJINEERA
ASSISTANTAENJINEERA
INSTRUMENTAMAN
DRAFTSAMAN
SCRUBBAWOMAN
BLUPRINTA BOY.

WAILING AND SHIVERY MUSIC PLAYED THRUOUT BY LONG NECK STENOGRAFTER.

(Enter division Enjineera at 8 A.M.) GOODA MORN GENTLEMEN, THINKA I'LL BEGON ALL DAY

(All together) GOODA MORN WE ALL GLAD YOUA GONE.

(Draftsaman in high tenor) WHATINHELLS THE MATTER WITH THIS DAMPLAN

(Bluprinta boy) OH! I FELLIKE HEL THINK ILL QUITTA JOB.

(All together) GETTA BACK ON THE JOBA

(Assistantajinjineera busily figuring.) YUL HAV TA STOP KIKIN MY DOG AROUN.

(Instrumentaman.) SHUTUPA, PABSTA BEER BETTERTHAN WATER. VOTESFOR WIMIN.

(Scrubbawoman entering with bucket of suds.) OH KABO KORSETSKI. CIGARO AND CIGARETTO. DIRTY HOLO.

(All together) Igotcha STEVE.

(Bluprinta boy) TRACING FELLA IN WATTER. ENJINEERSA DISTRESSA ROTTENPAPER HARCRI BETTA.!

(Division Enjineera returns, with high tenor, missed train.) THIS SOUNDSA LIKE BOILER SHOP. YEN SHE GAL, YENHOCK YIN YIN. SACARAMENTO, CALIFURN.

(Draftsaman rushing in blue print room runs tripod leg thru bluprinta boy.). NOW BILTAFT YOURADEADWUN. TEDISTHE MAN.

(Scrubbawoman fiercingly, pours bucket of suds over injineera) OH MEIN GOTT, HOCK DER KAISER, HOCK MY JUELRIE. GETTA RICH QUICK WALLINFORD.

(Instrumentaman waking up) (Quietly in sotto voce) THINKA ILL RUN FOR PRESIDENT, OF U.W.W. NOTENUFA MONEY HERE FORAME.

(Division Enjineera destroying tracings and blue prints.) THINKA ILL TAKA LONGA TRIP. GENEAL SUPER IN TEND.— JENERAL DEBILITA – CREDO AND GENERAL ARTHA.

(Draftsman) OH WHATAMI TO DO. I SHOOD WORRY.

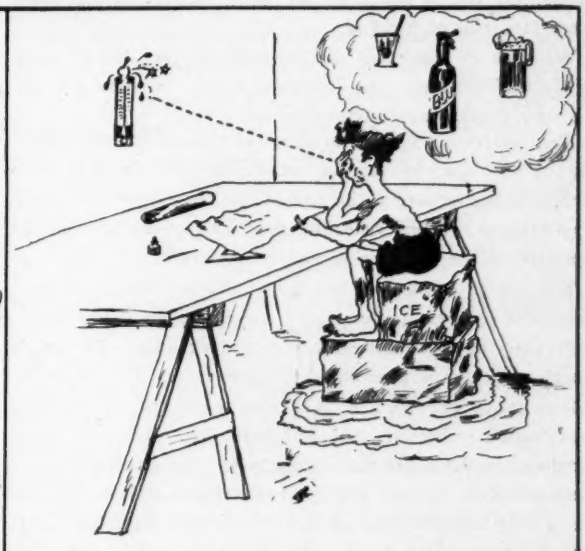
(Eats thumbtacks and drinks pint of Higgins black). SELA

(Scrubbawoman drinking remainder of bucket of suds then succumbs.) OH HO BO KEN NEW JERSEE. BULL MOOSO - BULL DURAM AND FATIMOS. (lays down quietly and dies.).

(Assistantajinjineera beating his chest with blue print) KUFFEL AND ESSERO.! WHAT IN HELENA MONTANO SHALL I DO O.? WIFE IN HOPITALO. KIMONA CUT OUTO BY DRESSMAKERA. (throws himself in blue print vat and drowns)

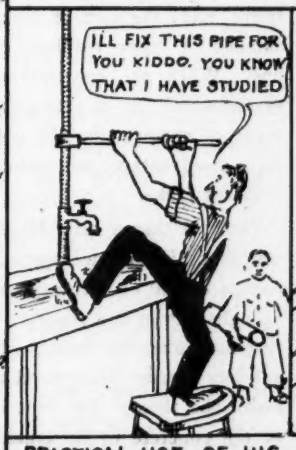
CURTAIN.

Music until final drop.



OH WHATS THE USE OF DREAMING

Yes Jimmo the draftsman spent a very quiet evening at home, last night, it was one evening that he didnt have to work so late making new estimates for several proposed G.M.O.s. So he played with baby all evening and let the young hopeful listen to his ticky tick. Next morning he awoke to find he had only time to catch the car and be at his duties on time, and arrived at the office only to find the office clock hands at six-thirty. Curses on you taper tail.



PRACTICAL USE OF HIS COLLEGE EDUCATION.

Oh Yes! Our Draftsman sees all the good shows.

CONCRETE DEPARTMENT

Concrete Department Heading.

IN THE past few months we have received several inquiries as to the name and location of the concrete arch bridge, the cut of which we are using as part of our Concrete Department heading.

We wish to state that this structure is the Paulin's Kill Viaduct of the Delaware, Lackawanna and Western Ry. on the new Hopatcong-Slateford cut-off.

The illustration of this bridge was chosen for the heading of our concrete section because of the fact that this structure is conceded to be one of the finest appearing railway bridges and one reflecting the best modern practice in concrete bridge engineering and construction.

This bridge consists of five 120-ft. and two 100-ft. circular reinforced concrete arches, with transverse open arched spandrels carrying a reinforced concrete deck slab. The total length of bridge is approximately 1,100 ft. and the height is 115 ft. above ground line. The abutments are of skeleton construction consisting of three longitudinal reinforced walls carrying the deck slab for approaches. The earth embankment takes its natural slope between walls and outside of them, thus balancing the earth pressure and making a light section adequate for walls. The piers are of plain concrete, rubble concrete being used below ground line.

The deck slab is waterproofed with four layers of felt and five layers of waterproofing compound protected by brick. Six-inch drain tile, without bells, laid on a ½ per cent grade along middle of slab, which slopes from copings toward center, affords drainage for the structure. Upon this waterproofed slab is placed a 3-foot fill of field and small stones and upon this 12 inches of ballast, carrying track.

Concrete Water Tanks.

IN OUR September, 1912, issue was published an editorial on concrete water tanks based on the American Railway Engineering Association's Water Service Committee report for 1911, which report was published in full in our April, 1912, issue. The 1912 report of the committee on "Concrete Tank Construction" of the American Railway Bridge and Building Association and published elsewhere in this issue sustains the contentions set forth in the editorial mentioned above, as is shown in the following:

In the first place, the advantages cited are in all cases the same, i. e., low maintenance cost and great durability.

The disadvantage of innovation is shown to be discredited to a certain extent, by the list of structures recently built, given in the report. Regarding imperfections in material and workmanship the committee says: "Many arguments are advanced against the concrete tank, the chief one being that poor workmanship will result in a defective tank, and this cannot be readily discovered or remedied. The statement is true, but it is also true of all other forms of construction. The remedy is careful, conscientious and competent supervision in selecting materials and doing the work." This it will be seen is exactly the same stand as taken in our editorial when we say it is unjust to consider that concrete tanks should be built with common unskilled labor.

Regarding greater first cost, the committee says: "The concrete tank costs more than other tanks, but the first cost ought not to be the governing feature. A careful comparison should be made of different designs and styles of construction of tanks having the same capacity and serving the same purpose, and the cost per annum in each case, arrived at."

"When the life of the tank is taken into consideration the latter will more than offset the increased cost of construction. The concrete tank is more costly than the wooden or steel tank, but the steady increase in the price of lumber and more improved methods of concrete construction are steadily reducing the difference."

The cost of a concrete tank depends very largely on the *experience and organization of the force* in this line of work, *the arrangement of plant and the efficiency thereof.* A gang experienced in erecting tanks will build a tank very much better and quicker than a force of untrained, inexperienced men, and hence at a much lower cost. The lay-out of plant, including the kind and operation of tank wall forms, has an important bearing on the cost. The proper plant is the one which while giving the required output results in the lowest cost per yard of concrete due to plant charges, depreciation and value of unsalvaged plant parts. The proper type of forms to use is that type which can be used over and over without becoming marked or broken, thus lowering the unit cost chargeable to forms. This requirement means that the forms must be of metal well braced and arranged so that they can be raised for next pouring at a very low cost. The old type of wood forms made the cost of tanks very high on account of the amount of labor required to set up and keep forms in line. When the construction of concrete tanks becomes systematized in a manner similar to that of other types of construction the cost of a concrete tank will not be a disadvantage, but rather an advantage over the other kinds of tanks.

The fact that a carefully proportioned mixture and good workmanship are necessary to build a tank which is not porous or full of shrinkage and tension cracks is forcefully brought out in the report. In speaking of seepage occurring soon after the tank is filled the committee says: "Seepage has usually disappeared after a few weeks and tends to prove the theory that, whether it is caused by porousness of the concrete or by cracks developing because the concrete is stressed beyond its elastic limit, precipitates from the water soon fill up the interstices and the tank becomes absolutely water tight."

With reference to the "Difficulty of Waterproofing," the report states: "With properly graded material and careful placing of same it is possible to get a concrete that should not require more than an application of bituminous paint on the inside to prevent any seepage of water." Compare this with our paragraph on waterproofing on p. 419 and note the similarity of the two statements.

"The committee is of the opinion that when subjected to the severest winter weather the concrete tank will stand up better than tanks of other materials. This opinion is based on experiences of engineers engaged in water supply and cannot be substantiated by facts."

Regarding "immovability," it seems to be the opinion of the committee that this disadvantage is being done away with, "by the new practice of placing the tank farther away from tracks at water stations and conducting water to engines through pipe lines and water columns, thereby making the tank a permanent structure. This decreases the necessity for a structure that can be moved on account of track changes and makes the concrete tank possible."

From the above it will be seen that our contentions as to the adaptability and merits of concrete water tanks for railway service are supported by this later report in nearly every detail. The report shows that the subject was given very careful consideration and it is hoped that future reports will aid in placing concrete tanks in such a favorable light that they will enjoy the popularity they rightfully deserve.

Reinforced Concrete Culvert Pipe.

THE INCREASED use of reinforced concrete in different types of railway structures has brought forth reinforced concrete pipe of various types and sizes as substitutes for cast iron culvert pipe and wood box culverts of relatively small size of opening. The popularity that this kind of pipe has attained is shown in a forceful manner by the committee report of the American Railway Bridge and Building Association on Concrete Culvert Pipe.

Concrete pipe has attained this popularity in spite of the unfair fight waged upon it by the vitrified clay pipe interests. The fact that some of the first concrete pipe made was manufactured by men who sought to get rich in a short time and consequently cut the amount of cement used down to such a small quantity that the resulting pipe was very porous (sometimes mostly sand) and soon disintegrated, furnishes the basis for the attacks on concrete pipe. At present, however, this purely mercenary spirit has been replaced by a desire to manufacture pipe constructed of rich concrete and reinforced with steel rods and wire mesh in such a manner as to make it as strong and durable as cast iron pipe.

The reasons for the extensive use of concrete pipe (extracts from committee report) are in brief as follows:

1. Pipe can be designed to meet all conditions of loading.

2. Sections up to 48 inches in diameter can be made whose weight will permit handling by same methods by which cast iron pipe can be handled.

3. Concrete pipe can be built in a central yard and shipped out for distances of 600 miles and still cost less than cast iron pipe.

4. The saving by the use of concrete pipe in place of cast iron depends upon local conditions, but is in general from 25 to 50 per cent.

5. In permanent work, where timber trestles are being filled and the drainage area is such as can be cared for by a pipe, a reinforced concrete pipe up to a diameter of 48 inches is the most economical opening to provide.

6. Well made concrete pipe is stronger, as shown by tests and probably more durable than cast iron pipe.

7. A reinforced concrete pipe, as shown by tests, is more apt to fail gradually in event of breaking under fill than will cast iron pipe. So far no failures are reported.

UNIQUE METHOD OF TESTING A REINFORCED CONCRETE ARCH BRIDGE.

A reinforced concrete arch bridge recently built near Farnsworth, England, no doubt, bears the unique distinction of being the only highway bridge tested by means of an hydraulic load.

The structure recently described in *Engineering* (London) is an overhead railroad crossing built on the Kahn system and designed for a uniform live load of 250 lbs. per sq. ft. The arch consists of three arch ribs with a span of 57 ft. and a rise of 8 ft. 3 inches, resting on plain concrete abutments faced with ashlar masonry, the roadway decking and spandrel wall being supported by the arch ribs.

In order to load the bridge for the test, clay dams were built at both ends of bridge, between parapets, and water was supplied through a 2½ hose.

A period of eight hours was required to apply the proper load in this manner. The resulting deflection under load was 1/16 inch at the center or less than 1/10,000 of the span.

GOOD FORMULA FOR CONCRETE.

"Cement, sand, gravel, water, experience. To compound the formula; take cement, one part; sand, three parts; gravel, five parts; water enough to give the desired consistency; experience all you have and all you can beg, borrow or swipe; and then you will have none too much.—*Chain Belt.*

TUNKHANNOCK VIADUCT.

The Tunkhannock Creek viaduct, now under construction on the Martin's Creek line of the Delaware & Lackawanna R. R., it is said, is to be the largest reinforced concrete railroad viaduct in the world. This structure is to have a total length of 2,230 ft., composed of two circular arches of 100 ft. clear span and eight circular arches of 180 ft. clear span, width of bridge being 34 ft. All piers will be of reinforced concrete founded on bed rock, the height of some of them being about 170 ft. from rock to springing line of arches. The height from stream bed to intrados of arches at crown will be approximately 100 ft. The elevation of base of rail will be about 36 ft. above intrados of arches, the track slab being carried on transverse spandrel arches. The main arches will be composed of two reinforced concrete ribs about 14 ft. wide and 8 ft. thick at the crown. Reinforced concrete caissons are to be sunk in the construction of some of the higher piers, which will be 40 ft. wide.

Concrete Practice No. 4

OKLAHOMA RAILWAY.

The structures described are in use on an electric interurban road but are given for comparison with standards of steam roads, as to designing loads and details. The live loads used (Cooper's E-50) are exceptionally heavy for electric traction and are an indication of the tendency on the part of the railways to use heavier loadings in design of railway structures.

Plain Concrete U-Abutment.

The concrete used in the abutment shown was a 1 : 2 : 4 mixture with crushed stone as the coarse aggregate. The footing 4'-0" thick projects 1'-0" beyond each side of abutment proper.

Horseshoe Arch Culvert, Oklahoma Ry.

The facings of wings and breast wall are battered 2" in 12"; the backs are vertical. The wings have a width of 2' at the top of parapet which is 6'-4" high, the base of wings being about 30 per cent of total height to top of parapet. The backwall 2'-0" thick extends 6'-4" above the bridge seat and has vertical face and back. The front of abutment is cut off at corners at an angle of 45° from point of intersection of face of parapet and backwall, thereby saving considerable masonry and, in fact, adding to, rather than detracting from, the appearance of the structure. The bridge seat is 3'-6" wide over all, and 11'-6" long at front under coping, which is 2'-0" thick and projects 6" beyond the abutment face. The ratio of base to total height for breast of abutment is about 40 per cent. Cooper's E-50 loading was used in design.

Reinforced Concrete Horseshoe Arch Culvert.

The concrete used in construction of this culvert was a 1 : 3 : 5 mixture, crushed stone being used.

The arch which is of the segmental type is reinforced transversely with ½" square twisted bars of medium steel, staggered 6" centers in extrados and intrados of arch. The total percentage of steel at the crown is about ½ of 1 per cent. Longitudinal bars are ½" squares spaced 2'-0" on centers near intrados of arch. The reinforcement for arch ring is carried into the abutments as shown. A small parapet is formed at the end of arch which gives the arch a heavier appearance. The end or wing portion, which is a continuation of culvert barrel, cut off at an angle parallel with slope of fill, is reinforced with transverse bars bent as shown and also by longitudinal bars from culvert barrel.

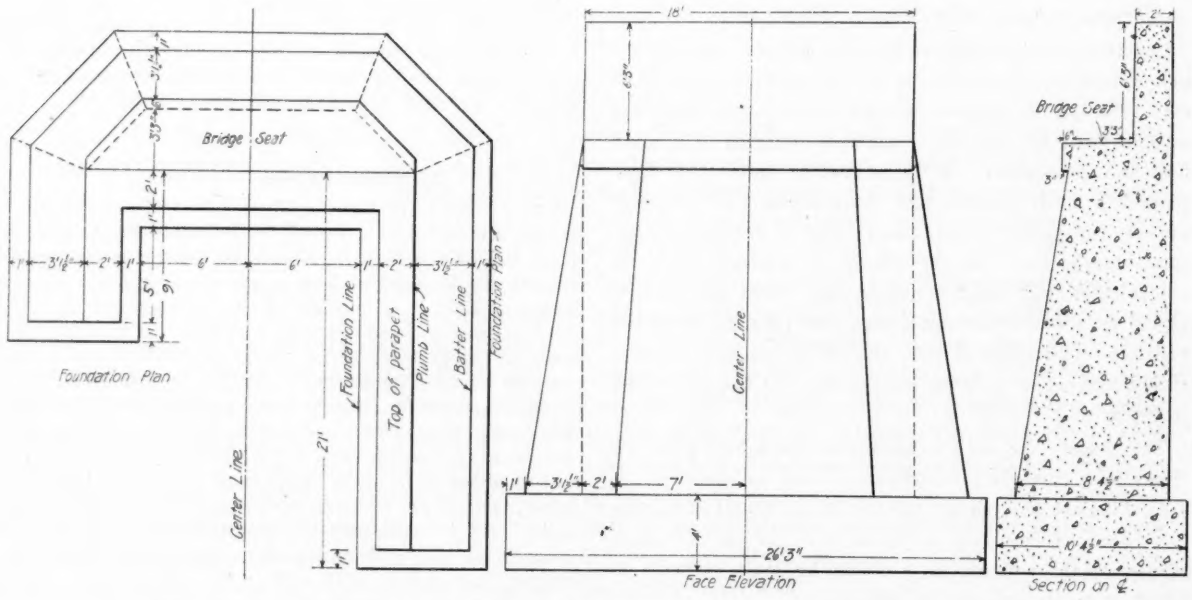
The designing loads were: live load, Cooper's E-50 with 25 per cent impact; dead load, concrete, at 150 lbs., and earth at 100 lbs. per cubic foot. Depth of fill over crown of arch was assumed as 4'-6". Unit stresses used were: tension in steel 16,000 lbs. per square inch; in concrete, 600 lbs. per square inch compression.

No waterproofing of any kind was used on the structure. The amount of reinforcing steel used per cubic yard of concrete was about 43 lbs., the amount of concrete used being 69 cubic yards, with 1½ tons of reinforcing steel. The formwork amounted to 1,800 square feet of surface.

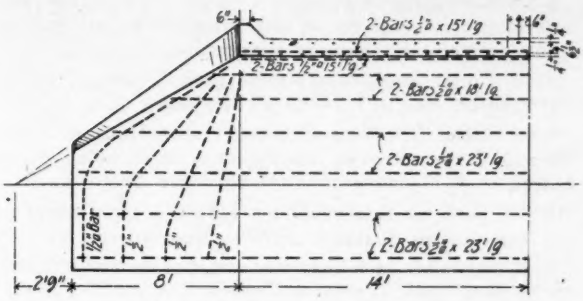
The road has built about 400 ft. of concrete culverts of the types shown, on one of their extensions, the greater portion being of the horseshoe type. This latter type has proven more economical to build, no side wings being necessary and the culverts can be extended more readily in widening the roadbed for an additional track.

Reinforced Concrete Box Culvert.

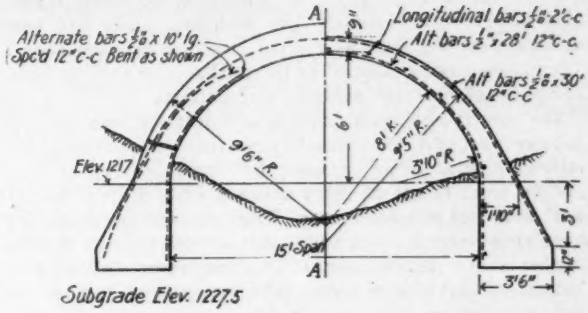
The culvert shown is a combination highway and railway box culvert with 30° wing walls.



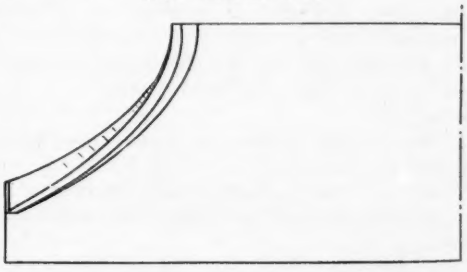
Plan, Elevation and Section of U-Abutment.



Half Section A-A

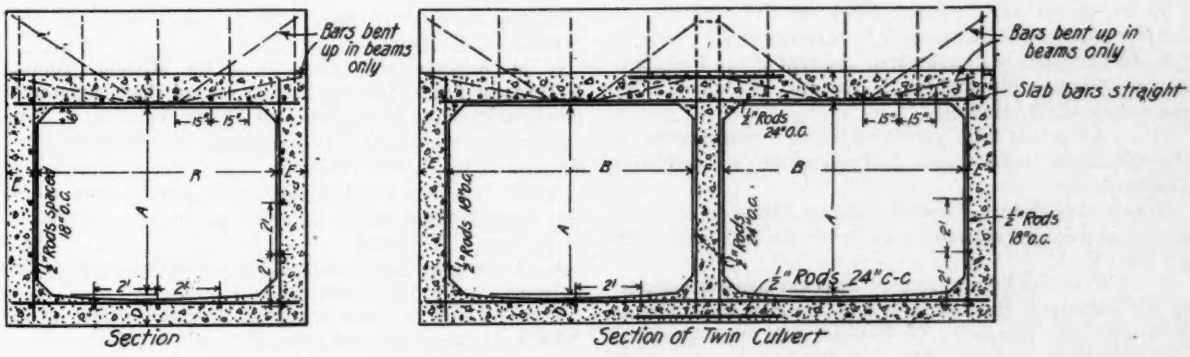


Subgrade Elev. 1227.5

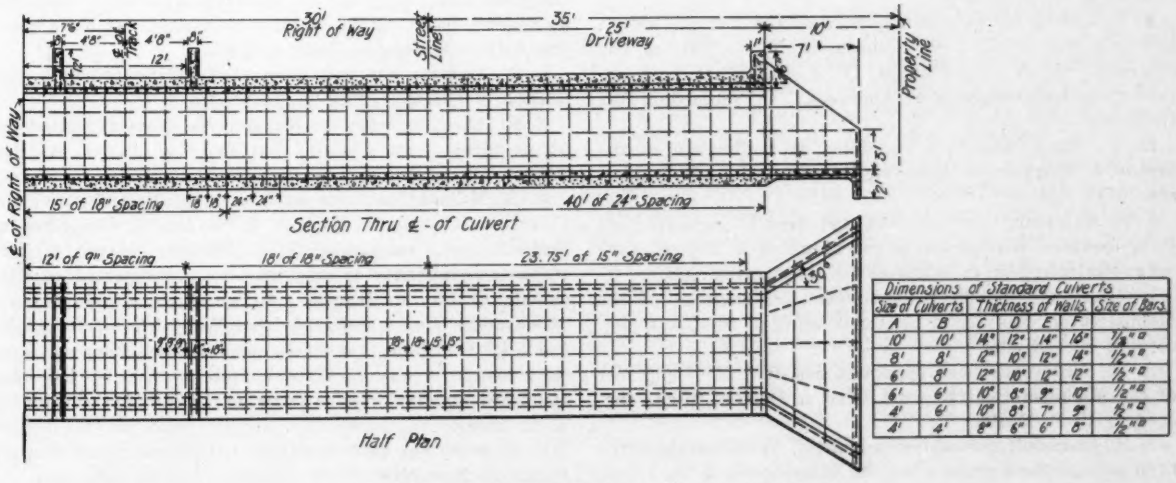


	REQUIRED
128	½" ø Twisted Steel Bars 10' Long
6	" " " " 15' "
8	" " " " 18' "
16	" " " " 23' "
28	" " " " 28' "
28	" " " " 30' "
36	Cubic Yards Sand
60	" " Crushed Stone
85	Barrels Cement

Reinforced Concrete Horseshoe Arch Culvert.



Transverse Sections of Reinforced Single and Double Box Culverts.



Dimensions of Standard Culverts.						
Size of Culverts		Thickness of Walls.				Size of Bars.
A	B	C	D	E	F	
10'	10'	14"	12"	14"	16"	1⅛" ø
8'	8'	12"	10"	12"	14"	1" ø
6'	8'	12"	10"	12"	12"	½" ø
6'	6'	10"	8"	9"	10"	½" ø
4'	6'	10"	8"	7"	9"	½" ø
4'	4'	8"	6"	6"	8"	½" ø

Plan and Longitudinal Section of Single Box Culvert.

The concrete used was a 1 : 3 : 5 mixture, the coarse aggregate being crushed stone. The designing loads and unit stresses were the same as for the structure decribed above. The accompanying table gives the thickness of various parts and sizes of bars for different size culverts.

The culvert slab is of uniform thickness for highway and railway portions, the necessary increase in strength for railway portion being obtained by closer spacing of bars and by cross beams 20" high above the top of slab, spaced 4'-8" each side of track center. The bars in these beams are bent up as shown, with additional vertical bars to provide further shear reinforcement. The transverse slab bars in bottom of slab are straight. The longitudinal bars act as distributing bars. The bottom slab is reinforced in a similar manner as shown. Sidewalls are reinforced vertically and horizontally, near inner face.

The double box section is reinforced in a manner similar to the single box section. Short straight bars are placed at bottom of slab under the center wall to care for negative moment at that point. The short straight bars in top of cover slab perform a similar duty.

The parapet wall is reinforced transversely and also has vertical bars tieing it to the slab. The bottom slab between wings is made about half the thickness of main bottom, and terminates in a baffle wall extending 2' below top of slab to prevent scour; 6" fillets are placed at junctions of side walls and slabs.

Personals

W. H. Brown has been appointed superintendent of the Albany Southern, succeeding J. P. Maloney.

B. L. Bugg has been appointed assistant general manager of the Atlanta, Birmingham & Atlantic at Atlanta, Ga., succeeding W. R. Hudson.

James Smith has been appointed bridge superintendent of the Cincinnati, Georgetown & Portsmouth with office at Cincinnati, O.

Robert C. Falconer, formerly division engineer, has been appointed principal assistant engineer of the Erie, with office at New York.

G. S. Waid has been appointed assistant general manager of the Galveston, Harrisburg & San Antonio, with office at Houston, Tex., succeeding G. Radetzki. R. M. Hoover has been appointed superintendent at El Paso, Tex., succeeding G. S. Waid, promoted.

P. J. Carter has been appointed assistant engineer on the Gulf, Colorado & Santa Fe, with office at Galveston, Tex., succeeding E. H. Olson.

R. L. Gebhardt, division engineer of the Lehigh Valley, has been transferred from Auburn, N. Y., to Easton, Pa., succeeding R. A. Van Houten. T. J. Burke has been appointed division engineer at Auburn, N. Y., succeeding Mr. Gebhardt.

H. E. Adams has been appointed superintendent of the Lorain & Southern at Amherst, O., succceeding E. Sanderson.

J. A. Kaufman, vice president and general manager, and J. T. Edwards, roadmaster of the Manistee & Repton, have been transferred from Manistee to Monroeville, Ala.

Hollis Marsh has been appointed chief engineer of the Manufacturers Railway of St. Louis, office at St. Louis, succeeding E. C. Finley.

A. L. Sarvey has been appointed assistant chief engineer of the Michigan Central, with office at Detroit, Mich., succeeding F. P. Marble.

J. H. Reinholdt, formerly roadmaster, has been appointed principal assistant engineer of the Minneapolis & St. Louis, with office at Minneapolis, Minn.

C. N. Kalk, formerly principal assistant engineer, has been appointed chief engineer of the Minneapolis, St. Paul & Saulte Sainte Marie, office at Minneapolis, Minn.

A. E. Potter has been appointed general manager of the Narragansett Pier R. R., office at Providence, R. I.

A. J. Orem has been appointed superintendent of the Nevada Copper Belt at Ludwig, Nev., succeeding S. S. Arentz.

C. W. Ford has been appointed general superintendent of the New Orleans Southern, office at New Orleans, La.

S. R. Payne has been appointed assistant general manager of the New York Central & Hudson River, with office at Rochester, N. Y. T. W. Evans has been appointed general superintendent, with office at Syracuse. H. E. Brown has been appointed superintendent at Buffalo, N. Y.

W. J. Davidson has been appointed superintendent of the Oregon Electric, with office at Portland, Ore., succeeding C. D. Phillipp.

J. F. Deimling has resigned as chief engineer of the Pere Marquette, Detroit, Mich.

R. Craig has been appointed superintendent of the San Diego & Southeastern at San Diego, Cal., succeeding E. A. Hornbeck.

F. S. James has been appointed superintendent of the Texas Central, office at Waco, Tex.

A. L. Hamilton has been appointed roadmaster at Waco, Tex., succeeding J. P. Head.

F. R. Ramsey has been appointed chief engineer of the Toledo, St. Louis & Western, office at Frankfort, Ind.

T. J. Stryker has been appointed superintendent of the Wharton & Northern with office at Wharton, N. J., succeeding W. H. Force.

A. M. Acheson, chief engineer of the Missouri, Kansas & Texas of Texas, has also been appointed chief engineer of the Wichita Falls Route, office at Dallas, Tex. R. L. Hatfield has been appointed roadmaster at Wichita Falls, Tex., succeeding W. E. Robertson.

A. W. Hartford has been appointed general manager of the Youngstown & Southern, with office at Youngstown, O., succeeding E. H. Rauff.

H. R. Laughlin has been appointed superintendent of the Baltimore & Ohio at Jenkins, Ky.

J. A. Bennett has been appointed general manager of the Brandon & West Rutland, office at Bridgton, Me.

J. B. Dodds, roadmaster of the Canadian Northern, has been transferred from Dauphin, Man., to Hudson Bay Jct., Sask. T. Harris has been appointed roadmaster at Brandon, Man. J. A. Mosher has been appointed roadmaster at Daughin, Sask. C. F. Wessel has been appointed roadmaster at Kipling, Sask. O. M. Valde, roadmaster, has been transferred from Kipling to Radville, Sask.

J. W. Cuineen has been appointed superintendent of the Central of Georgia, office at Macon, Ga.

N. C. Allen, formerly trainmaster, has been appointed superintendent of the Chicago, Burlington & Quincy, office at Aurora, Ill.

C. S. Millard has been appointed superintendent of the Cleveland, Cincinnati, Chicago & St. Louis, with office at Wabash, Ind., succeeding S. T. Blizard. Joseph Mullen, engineer maintenace of way, has been transterred to Cincinnati, O. S. M. Brown, assistant engineer maintenance of way, has been transferred from Wabash to Indianapolis, Ind. L. B. Elliott has been appointed assistant engineer maintenance of way at Wabash, Ind. D. C. Clay has been appointed supervisor of signals at Galion, O., succeeding T. E. Lutz.

P. Peterson has been appointed roadmaster of the Copper Range at Houghton, Mich., succeeding John Sammons.

George Mercer, bridge foreman of the Duluth, South

Shore & Atlantic, has been transferred from Bay City to Marquette, Mich.

J. R. Garrabant has been appointed signal inspector of the Erie at Marion, O., succeeding E. O. Rogers. R. T. Davis has been appointed supervisor of track at Jersey City, N. J., succeeding C. H. Corcoran. J. Hart has been appointed supervisor of track at Bradford, Pa., succeeding G. L. Foster. T. Toomey has been appointed supervisor of track at Elmira, N. Y., succeeding W. J. Flynn. A. E. Monahan, supervisor of track, has been transferred from Akron to Marion, O.

J. Goodfellow, formerly assistant superintendent, has been appointed general superintendent of the Esquimalt & Nanaimo, office at Victoria, B. C. H. J. Cambie, chief engineer, has been transferred from Victoria to Vancouver, B. C.

E. T. Lamb has been appointed general manager of the Fitzgerald, Ocilla & Broxton, office at Atlanta, Ga., succeeding A. Bonnyman.

F. T. Shuff has been appointed superintendent of the Fort Dodge, Des Moines & Southern, office at Boone, Ia. L. E. Gagnon, formerly superintendent of bridges and buildings, has been appointed superintendent maintenance of way, office at Boone, Ia.

G. H. Emerson, formerly assistant general manager, has been appointed general manager of the Great Northern, office at St. Paul, Minn. He succeeds J. M. Gruber, who has been appointed vice president.

W. C. Faysson has been appointed superintendent of the Greeneville & Knoxville, office at Greeneville, S. C.

F. T. O'Dowd, roadmaster on the Gulf, Colorado & Santa Fe, has been transferred from Temple to Cleburne, Tex.

J. P. Lynahan, roadmaster of the Gulf, Florida & Alabama, has been transferred from Muskogee to Pensacola, Fla.

A. Crable, formerly division engineer, has been appointed engineer maintenance of way of the Hocking Valley, office at Columbus, O. J. E. Johnson has resigned as division engineer at Logan, O.

D. L. Gallagher has been appointed superintendent of the Houston & Texas Central at Ennis, Tex., succeeding W. T. Hall.

R. T. Walker, formerly trainmaster, has been appointed superintendent of the Houston, East & West Texas, office at Houston, Tex.

J. M. Garver, assistant roadmaster Illinois Central, has been transferred from Kankakee to Champaign, Ill. M. L. Conley has been appointed supervisor of track at Freeport, Ill., succeeding P. J. Lonergan. L. McMurray has been appointed supervisor of track at Clinton, Ill., succeeding D. J. McCann. G. E. Surrells, supervisor of track, has been transferred from Sullivan, Ind., to Newton, Ill.

R. H. Emmerson, formerly division engineer, has been appointed division engineer maintenance of way, of the Intercolonial, office at Lewis, Que. T. McPherson, general roadmaster, has been transferred from New Castle to Moncton, B. C.

W. W. Yeatman has been appointed superintendent of the Jonesboro, Lake City & Eastern, office at Jonesboro, Ark., succeeding G. C. Nichols.

E. D. Hogan, formerly assistant superintendent, has been appointed assistant general manager of the San Antonio & Arkansas Pass.

E. W. Batchelder, formerly division superintendent, has been appointed assistant general superintendent of the Erie, with office at Marion, O.

J. C. Muir, formerly general superintendent, has been appointed superintendent of the Chicago & Eastern Illinois, with office at Danville, Ill., and the former position has been abolished. He succeeds G. H. Trenary, who has been transferred to Salem, Ill., succeeding P. S. Sampson.

S. Ennes has been appointed superintendent of the Great Northern at Superior, Wis. B. Lantry has been appointed superintendent, also with office at Superior, Wis. G. S. Stewart, superintendent, has been transferred from Superior, Wis., to Havre, Mont., succeeding F. D. Kelsey. Mr. Kelsey has been transferred to Breckenridge, Minn.

A. B. Ziegweid has been appointed division engineer of the Pere Marquette, with office at Saginaw, Mich.

L. F. Lonnbladh, formerly chief engineer, has been appointed superintendent of the Tennessee Central at Nashville, Tenn., succeeding L. S. Bourne.

J. A. Fairbairn has been appointed acting superintendent of the Northern Railway of Costa Rica, succeeding H. C. Owen, office at Limon, Costa Rica.

N. R. Howard, formerly assistant superintendent, has been appointed superintendent of the Chicago, Burlington & Quincy at Burlington, Ia., succeeding O. E. Stewart.

J. L. Beall has been appointed engineer maintenance of way of the Atlanta, Birmingham & Atlantic, office at Atlanta, Ga.

J. B. Gant, formerly inspector of bridges of the Illinois Central, has been appointed inspector of bridges of the Grand Trunk, office at Montreal, Que.

J. B. Kelly, roadmaster of the Minneapolis & St. Louis, at Minneapolis, has had his jurisdiction extended over the territory formerly under supervision of J. H. Reinholdt.

H. E. Brashares has been appointed signal engineer of the Great Northern, with office at St. Paul, Minn., succeeding C. A. Dunham, resigned to accept service with another company.

J. W. Foote has been appointed division engineer of the Erie, office at Salamanca, N. Y., succeeding Harold Knight. Mr. Knight has been appointed division engineer, with office at Jersey City, N. J., succeeding R. C. Falconer, transferred.

Arthur B. Caldwell has been appointed division engineer of the New York, Susquehanna & Western, office at Jersey City, N. J., succeeding J. W. Foote, appointed division engineer of the Erie.

RAILWAY CONSTRUCTION.

The Clarksburg & Northern has been sold to New York capitalists. This company is building from New Martinsville, W. Va., south to Salem, 49 miles, and grading has been finished to Middlebourne.

The Lufkin, Hemphill, Hempstead & Gulf has been incorporated in Texas with $100,000 capital and headquarters at Hemphill, Tex. The plans call for building from Kindred, in San Augustine county, Texas, east to a point on the Sabine river in Sabine county. The incorporators include H. Knox and G. E. Pratt of Hemphill. C. B. Callins, Lufkin; W. M. Kady and B. E. Smith of McNary, La.; R. Stack, Woodworth, La., and A. MacDonald, Houston.

The Grand Trunk Pacific is striving to complete the branch line from Talmage to Weyburn, Sask., this year. In order to counteract the shortage of men available it has decided to withdraw a number of gangs from the Regina boundary branch and transfer them to Weyburn. A large survey party is now at work east of Talmage locating a line to link up this branch with the main line just east of the Manitoba boundary, which will replace the line originally projected from Brandon to Weyburn. It will cross the Canadian Pacific in the vicinity of Moosomin and will give a short and direct connection with Winnipeg.

The Alexander & Eastern, it is reported, has completed a survey for an extension to be made along Back Fork to Elk river.

The Signal Department

Railway Signal Association

REPORT OF COMMITTEE I—SIGNALING PRACTICE.

As a result of several years' study, the committee, in 1907, arrived at the conclusion that the basis of a uniform system of signals should be the control of the train. During the succeeding two years the committee, after exhaustive study and investigation of the subject, was unable to agree:

First, as to the number of indications that should be given by fixed signals;

Second, as to the wording of the indications;

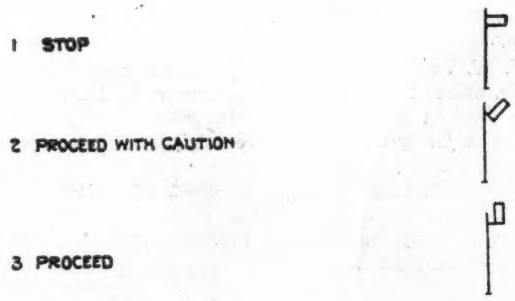
Third, as to the aspects or forms of the signals that should be used to represent the several indications.

In 1910 The American Railway Engineering Association requested the American Railway Association to bring the matter to the attention of its Committee on Transportation for decision. The Committee on Transportation heard arguments at a meeting in June of that year and reported as follows:

"The reports of various Committees of the Railway Signal Association and of the American Railway Engineering Association on the subject of signaling have been submitted to this Committee, with the request that the essentials of signaling be outlined or defined for the future guidance of their Committees.

Scheme No. 1.

Fundamentals.



"The subject has been carefully analyzed and considered. There are three signals that are essential in operation and therefore fundamental, viz:

"(1) Stop.

"(2) Proceed with caution.

"(3) Proceed.

"The fundamental, 'proceed with caution,' may be used with the same aspect to govern any cautionary movement; for example, when:

"(a) Next signal is 'stop.'

"(b) Next signal is 'proceed at low speed.'

"(c) Next signal is 'proceed at medium speed.'

"(d) A train is in the block.

"(e) There may be an obstruction ahead.

"There are two additional indications which may be used where movements are to be made at a restricted speed, viz:

"(4) Proceed at low speed.

"(5) Proceed at medium speed.

"Where automatic block system rules are in effect, a special mark of some distinctive character should be applied at the stop signal.

"The Committee therefore recommends:

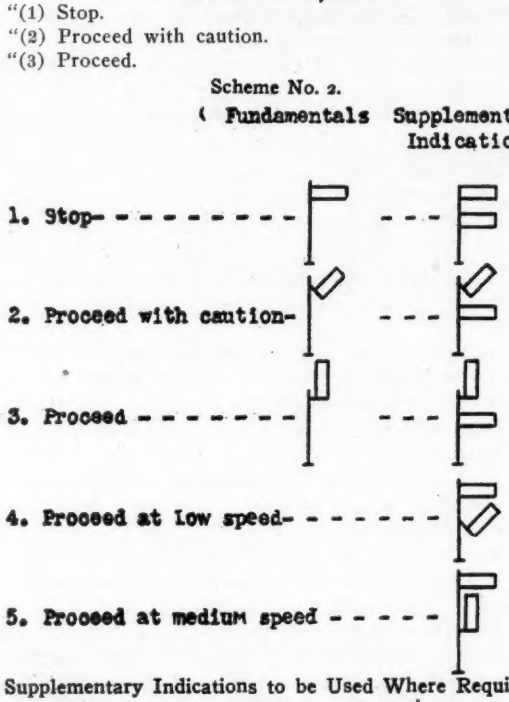
Signal Fundamentals.

"(1) Stop.

"(2) Proceed with caution.

"(3) Proceed.

Scheme No. 2.



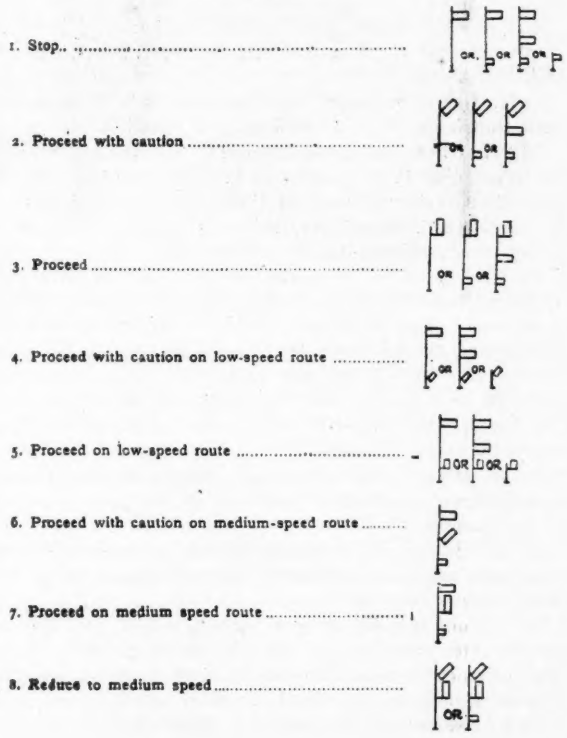
Supplementary Indications to be Used Where Required.

"(4) Proceed at low speed.

"(5) Proceed at medium speed.

"Stop signals operated under automatic block system rules should be designated by some distinctive mark to be determined by each road in accordance with local requirements."

Scheme No. 3.


1. Stop
2. Proceed with caution
3. Proceed
4. Proceed with caution on low-speed route
5. Proceed on low-speed route
6. Proceed with caution on medium-speed route
7. Proceed on medium speed route
8. Reduce to medium speed
OR

Recommendations of Committee I, Railway Signal Association.

The Committee submitted for approval the following two schemes of signaling in conformity with the recommendations of the Committee on Transportation.

As means of designating stop signals operated under automatic block system rules, the following are suggested:

1. The use of a number plate; or
2. The use of a red marker light below and to the left of the active light.

Having in view the practice of indicating diverging routes by several arms on the same mast, the Committee submitted for approval scheme No. 3 to establish uniformity in this practice.

Conclusion.

That the signal indications and aspects and the means of designating stop signals operated under automatic block system rules presented, be submitted to letter ballot for adoption.

On subject (b), "Investigate the applicability of the 'A G A' flash light, especially as a means of making any distinction in night signal aspects that may be deemed necessary," the Committee submitted a report as information.

Committee, A. H. Rudd, chairman; L. R. Clausen, vice-chairman; C. C. Anthony, H. S. Balliet, C. A. Christofferson, C. E. Denney, W. J. Eck, W. H. Elliott, G. E. Ellis, A. S. Ingalls, J. C. Mock, F. P. Patenall, J. A. Peabody, W. B. Scott, A. G. Shaver, T. S. Stevens, H. H. Temple, J. C. Young.

were submitted for consideration at the New York Meeting and were approved and accepted, with slight corrections, which have been made.

The Committee recommends the adoption and submission to letter ballot of the typical plans, numbers 1200, 1201, 1202, 1203, 1204, 1205, 1206 and 1217.

POWER INTERLOCKING.

The Chairman of this Committee, in connection with the Chairmen of Committees IV and VIII, prepared a classification of voltage ranges for signal work.

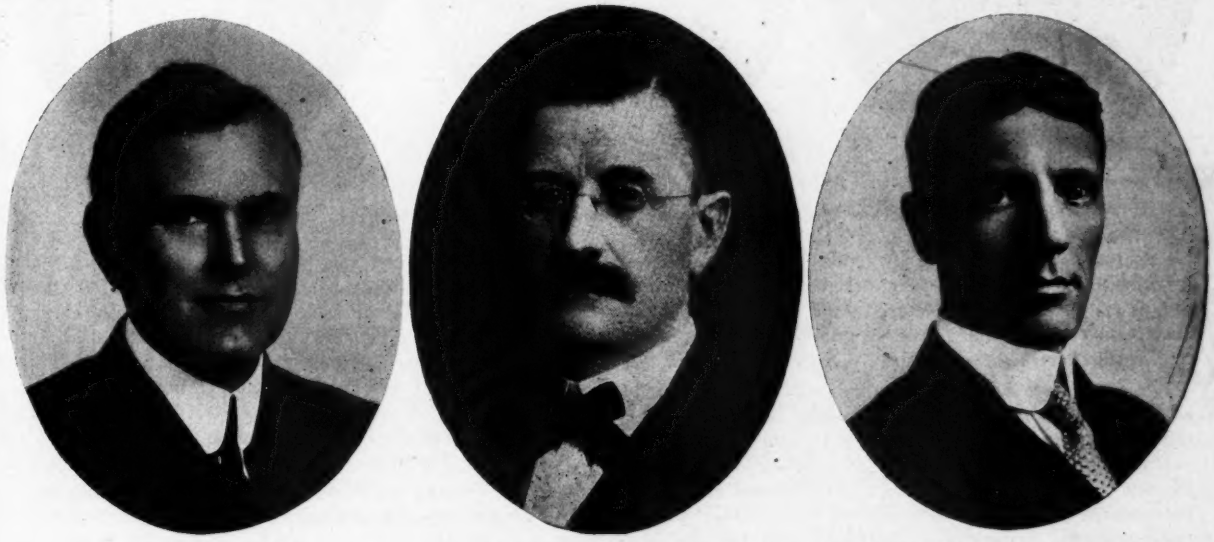
Sub-Committee "A" reported on:

(a) Specifications for apparatus and material used in power interlocking construction.

(f) The use of "battery" indication for semi-automatic power-operated signals.

Under (a) the Sub-Committee spent the time studying specifications for screw releases, electric lamps, fuses, annunciator bells, heavy current relay contacts, lightning arresters and push buttons, but is reported only upon specification for releases which were recommended for approval and submission to letter ballot. The other specifications are well under way and, in all probability, in another year's time they will be completed.

Sub-Committee "B" reported that at the last Annual Convention it submitted typical circuit plans Nos. 1110 to 1125 inclusive, showing Typical Circuits for Electric Interlocking. After the presentation of this it was found that improvements had been made and were under way on these



B. H. Mann, President. C. C. Rosenburg, Secretary. J. C. Young, Member Board of Directors.

Officers of the Railway Signal Association, 1912-13.

MECHANICAL INTERLOCKING.

The Committee recommended the adoption and submission to letter ballot of revised sections of specifications to supersede Sections 100, 101 and 102, Specifications for Mechanical Interlocking, and to be embodied in the specifications for material.

The Committee, in recommending specifications and typical plan of circuits for an electric bolt lock, carefully considered, and was guided by, all previous reports submitted to the Association by Committees II and III.

The Committee recommended for adoption and submission to letter ballot for approval the specifications for electric bolt lock, and as recommended practice typical plan of circuits, drawing 1216, for an electric bolt lock.

Typical schemes for lead-out foundations and lead-outs

plans, and corrected plans were submitted for consideration. In addition to this, four typical plans were submitted for Operating Switchboards and two additional plans for Circuits at Crossovers, one a bi-circuit indication and the other an a.c. indication, all of which were presented for approval as the recommended practice of the Association.

Sub-Committee "C" reported for consideration Specifications for Vitrified Clay Conduit and Specifications for Fibre Conduit, both for approval and submission to letter ballot.

Sub-Committee "E" presented certain corrections on Specifications for Electro-Pneumatic Interlocking, also Specifications for Protection of Drawbridges by Power Interlocking, and asked for approval and submission to letter ballot.

The Chairman of the Committee presented Classification

of Voltage Ranges for Signal Work and asked for final approval and submission to letter ballot.

AUTOMATIC BLOCK.

Sub-Committee 1.—"Revised specification for direct current relays and direct current indicators," spent all of its time on specifications for neutral relays and made some changes in those presented at the stated meetings, the most important being in section 4, paragraph (a), where the finish for parts in the sealed portion of the relay was changed to "Lacquer"; also in section 7, one stop pin was specified to be placed entirely outside and away from the core faces, and a different air gap was specified for two-finger and three or more finger relays.

Considerable time was spent in making tests of various relays. The Committee thought that it had secured a satisfactory "Magnetic Iron Test" but it found that, owing to the difference in design and construction of relays of different manufacturers, the test could not be universally applied unless the magnetic iron parts of all relays are constructed the same.

The Committee believes that these specifications, excepting sections 14, 15 and 16, as applying to all relays and the entire specifications as applying to four-ohm relays of two and four fingers is superior to anything yet produced. In view of this and the statement of the manufacturers that the present specification (adopted in 1906) cannot be met, the Committee suggested it might be well for the Association to adopt the specification presented, with the understanding that the Committee will continue work on the "Magnetic Iron Test" and adjustment data for relays of various resistance and number of contacts.

Sub-Committee 2.—"Separation of specifications for apparatus and material used in automatic signal construction," presented specifications for Railway Signal Association cell, also drawing for signal cell number 1053 and drawing number 1218 for number plate and numbers and asked that this be given consideration for approval and submission to letter ballot.

The Committee submitted comment on the question of revision of

Specifications for blue vitrol,
Specifications for zincs for gravity battery,
Specifications for gravity battery jars,
Specifications for copper for gravity battery,

and asked that consideration be given to drawing number 1218, showing progress report and the design of number plate and numbers.

Sub-Committee 3 was assigned (b), "Specifications for apparatus and material," and prepared design number 1223 for switch circuit control rod, lug and connection and asked that this be given consideration with a view of adoption and submission to letter ballot.

Sub-Commttee 4.—This Committee was assigned the revision of specifications for channel pins so as to make them applicable for use of copper plating, as well as tinning. Also to make corrections if found necessary and redesign the present standard channel pin as per drawing 1086 following.

In submitting the revised plan of channel pin, attention was called to the fact that they allowed for a longer and more tapered pin and also increased the length of the body of the pin, retaining the same diameter for the ends of the body of the pin, and figuring the taper of the axis accordingly. The Committee believes that the proposed pin will be easier to start in driving, and will permit better bonding. Both specifications and drawing were recommended for approval and submission to letter ballot.

This same Committee presented for consideration the use of rubber-covered wire in automatic block signal construction, giving sizes for different purposes. The title of this report is headed: "The use of Railway Signal Association rubber-covered, soft-drawn copper wire in automatic block signal system," and was recommended for adoption and submission to letter ballot.

Sub-Committee 9 submitted for consideration the following:

Specfications for wood crossarms,
Specfications for steel crossarm and pins,
Specifications for crossarm braces and heel and toe bolts,
Specifications for crossarm through bolts and double arm bolts,
Specifications for double petticoat glass insulators,

and the following drawings:

1089—Wood crossarms.
1165—Crossarm standard steel pin.
1166—Crossarm steel terminal pin.
1167—Crossarm pin cap gauge.
1221—Double petticoat glass insulators.

H. W. Lewis. R. E. Trout. C. A. Dunham.

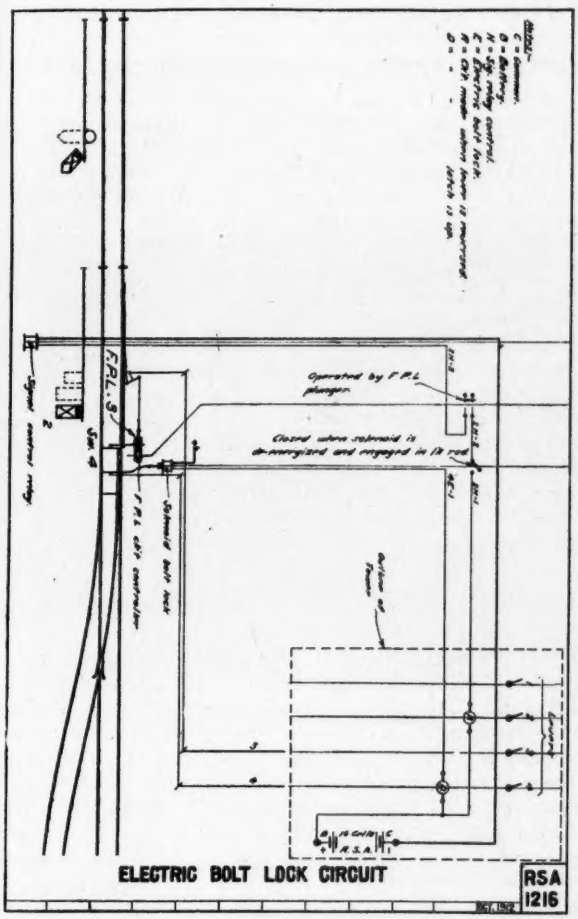
Members of the Board of Directors of the Railway Signal Association, 1912-13.

The specifications mentioned above, including drawings, were submitted for approval and submission to letter ballot.

The specifications for Crossarm Braces and Heel and Toe Bolts covers the fastening of the brace to the crossarm by a lag screw. The Committee expects to investigate the use of and provide a specification for carriage bolts for this purpose in its work of next year.

The Committee also presented specifications for galvanizing for iron or steel, and specifications for eastern white cedar poles, and recommended the same for acceptance and submission to letter ballot.

Committee—A. G. Shaver, Chairman, J. M. FitzGerald, Vice-Chairman, E. L. Adams, E. E. Bradley, G. H. Dryden, A. R. Fugina, J. E. Gillmor, R. E. Greene, W. R. Hastings,



W. H. Higgins, B. F. Hines, E. W. Kolb, J. E. Lyon, E. W. Newcomb, H. H. Orr, C. W. Parker, R. M. Phinney, H. J. Rhinehart, A. H. Rice, G. W. Trout, J. R. Wills.

MANUAL BLOCK.

Committee V was given the following instructions:

(a) Investigate the relative advantages or disadvantages, relative safety and relative cost (installation, maintenance and operation) of the various kinds of manual block systems (manual, controlled manual, and staff).

(b) Prepare rules for the maintenance and operation of interlocking plants and block signals. In this work it was recommended that this Committee seek suggestions from Committees II, III and IV.

(c) Investigate methods of handling trains by signal indications without train orders.

Prior to the June meeting the Committee held five meetings at which the attendance was very good. At these meetings subjects (a) and (b) were considered and a preliminary report presented at the June meeting on both subjects. After the discussion held at the June meeting it was found advisable to withdraw subject (b), "Prepare rules for the maintenance and operation of interlocking plants and block signals," for the reason that these rules are still subject to modification and should not be presented and take up the time of the Convention until the Committee has given the matter further consideration.

The Committee met finally to revise subject (a) to meet the approval of the action taken at the June meeting and presented the same for consideration and approval for submission to letter ballot with the understanding that subject (b) be considered as work for the Committee for the coming year.

Committee—T. S. Stevens, Chairman, L. A. Mann, Vice-Chairman, E. T. Ambach, Hadley Baldwin, J. Beaumont, J. H. Cormick, H. J. Foale, M. J. Fox, G. A. Guyer, F. E. Jacobs, G. S. Pflasterer.

SUBJECTS AND DEFINITIONS.

The Committee on Definitions presented the results of its work this year in two parts.

Part I contains 300 definitions of words, terms and phrases which were submitted for the final action and approval of the Association.

Part II refers to the work which the Committee has started but has not yet completed.

The work of the Committee since its appointment has covered a good deal more ground than is represented by the definitions. A large number of definitions have been tentatively prepared but are not yet sufficiently seasoned to be offered, even for the criticism of the Association.

The Committee's work has been carried on with the idea in mind that its results would comprise the signal dictionary which was referred to in its instructions. For that reason the work was planned on such a scale as would take more than one year to bring to a satisfactory conclusion. The Committee, therefore, asked for the adoption of the definitions in Part I of this report, and withheld Part II with the recommendation that the Committee be continued another year, and given full instructions and authority to prepare a dictionary of the words, terms, and phrases which are used in railway signaling, including both those which originated in and are peculiar to the art and science of signaling; and those which have been applied to it from other lines of work.

Committee—E. G. Stradling, Chairman, A. D. Cloud, C. G. Stecher.

ELECTRIC RAILWAY AND ALTERNATING CURRENT SIGNALING.

Sub-Committee A submitted text for a drawbridge on the New Haven, at Slades Ferry, Mass.; and signaling between Providence and Fall River and on the Harlem River Branch, both on New Haven Railroad, by Mr. C. H. Morrison, as Chairman.

Sub-Committee B. Messrs. W. P. Allen, W. F. Follett, J. Leisenring, W. Morrison, C. R. Peddle, J. Roberts, W. N. Spangler (9 months' term), F. E. Wass and E. B. Smith, Chairman, submitted specifications to be inserted in the various blank spaces in the recommendations approved by letter ballot in 1911. A design for a suitable lamp box was forwarded to the Chairman of the Standard Committee. In addition to this the Committee, through Sub-Committee Chairman Follett, presented an outline for transformers, which after slight revisions has the approval of the main Committee, also Sub-Committtee Chairman Leisenring presented specifications for impedance bonds where d. c. propulsion is used.

Sub-Committee C, consisting of Messrs. E. C. Grant, B.

H. Richards (about half of the year), J. D. Elder, J. R. Wills, W. F. Hudson, H. A. Logue, F. S. Starrett, Harmon Wickson, J. A. Beoddy, L. R. Byram, and J. E. Saunders, Chairman, prepared "Specifications and requisites of apparatus and material for alternating current block signal system (On all railways except those using direct or alternating current for propulsion)."

Sub-Committee D submitted a paper on the Pennsylvania Railroad installation, Jersey City to Newark, N. J., and on the same railroad at Bristol, Pa Rochester, Syracuse & Eastern, and Lake Shore & Northern Railways, by Mr. W. P. Allen, Chairman.

Sub-Committee E, Mr. C. R. Peddle, Chairman. Mr. Peddle reviewed all literature pertaining to Interborough Rapid Transit Company's installation in New York in our proceedings and in addition to supplying text to bring them up to date also provided subject matter covering the elevated division of this railroad in the city of New York.

Sub-Committee F, Mr. W. N. Spangler, Chairman, submitted text for a. c. track circuit and signal installations of Pennsylvania Tunnel & Terminal Co., New York.

Sub-Committee G, Mr. John Leisenring, Chairman, submitted further description of installations not previously treated, on signaling, on the Illinois Traction System.

Sub-Committee H, Mr. John Roberts, Chairman, submitted a description of the a. c. signal installation on the New York, Westchester & Boston.

Sub-Committee I submitted text for the Brooklyn Bridge and Terminals in New York and Brooklyn, Mr. F. E. Wass, Chairman.

Sub-Committee K, Mr. Harmon Wickson, Chairman, submitted a description of the signaling on the San Francisco, Oakland and San Jose Consolidated Railways (Key Route), at Berkeley, Cal.

Sub-Committee L, Mr. J. A. Beoddy, Chairman, supplied an account of a. c. installation on steam operated line, Norfolk & Western Railway.

Committee—H. S. Balliet, Chairman, C. H. Morrison, Vice-Chairman, W. P. Allen, J. A. Beoddy, L. R. Byram, J. D. Elder, W. F. Follett, E. C. Grant, W. F. Hudson, J. Leisenring, H. A. Logue, W. Morrison, C. R. Peddle, John Roberts, J. E. Saunders, E. B. Smith, F. S. Starrett, F. E. Wass, J. R. Wills.

WIRES AND CABLES.

The instructions of the Board of Direction in the matter of the work of the Committee for the year were given in reports made to the Association at the March and June meetings. The meeting of the Committee at which this report was decided upon was held in New York on June 28, the following being present: Messrs. Adams, Himes, Phillips, Richards, and Elliott, Chairman.

The preliminary reports referred to were fully discussed by the Association, and for this reason the conclusions only were given. These, together with minor additional recommendations, were submitted for acceptance and adoption by letter ballot.

This Association with a view to future adoption as a part of the mineral matter rubber compound specifications, recommended that the installation be applied to the wire by the stripping machine process and that Manufacturers prepare to comply therewith. That in placing orders for rubber insulated wire, Purchasers should, on the ground of the better quality of the insulation, give preference to those concerns that use the stripping machine process.

Committee—W. H. Elliott, Chairman, E. L. Adams, Vice-Chairman, W. L. Dryden, A. B. Himes, J. D. Phillips, D. W. Richards, E. L. Watson, J. V. Young.

REPORT OF SPECIAL COMMITTEE ON STORAGE BATTERY.

The Committee submitted for adoption by the Association Specifications for Lead Type Storage Battery for Interlocking, including plan number 1224, entitled "Lead Type Storage Battery."

Also plan number 1174, entitled "Charging Panel—Two Way."

This Charging Panel is designed for the charging of Automatic Signal Batteries by use of charging line. Its adoption is desired so that this plan may be used as typical as to arrangement of apparatus and size of board for future charging panels to be submitted by the Committee at a later date.

Committee—R. B. Elsworth, Chairman, J. Fred Jacobs, G. E. Beck, T. L. Johnson, A. H. McKeen, A. H. Yocum.

REPORT OF SPECIAL COMMITTEE ON CONTRACTS.

On June 26, 1912, the Secretary received from the Chairman, Mr. Clausen, a letter tendering his resignation as Chairman; also sending his entire file on the subject.

In taking this up with the President it was found that no meeting of the Committee had been held after the Stated Meeting in March, at which time the report on Table of Operated Unit Values had been referred back to the Committee for further consideration. The President decided that it was too late in the year to appoint a new Chairman and get a report ready for the Annual Convention.

In looking through the files several agreements were found which had been prepared by different members of the Committee for consideration. The matter was then taken up with the other members of the Committee, asking their advice in presenting to the Annual Convention a copy of these agreements for consideration, with a view of either adopting them or referring them back to the Committee for further action, and as a majority of the members replied in the affirmative the agreements were presented and are in accordance with report presented at the last Annual Convention and found in the Journal of 1911.

ELECTION OF OFFICERS.

The following officers were elected for the following year: President, B. H. Mann, signal engineer, Missouri Pacific; vice-president, T. S. Stevens, signal engineer, Atchison, Topeka & Santa Fe; secretary-treasurer, C. C. Rosenberg. The new members of the Board of Directors elected for two years are: J. C. Young, signal engineer, Union Pacific; H. W. Lewis, signal engineer, Lehigh Valley; R. E. Trout, signal engineer, Frisco System, and Charles A. Dunham, signal engineer, Great Northern.

EIGHT CUTS

The Baltimore & Ohio, it is said, will reconstruct the transfer bridge at pier 40 on Poplar St., in Philadelphia, Pa., at an estimated cost of $40,000.

The Canadian Northern Ontario, it is reported, has been authorized by the board of railway commissioners of Canada to construct a bridge over the Humber river in the township of York, county of York, at a point 6.32 miles west of Toronto.

It is reported that the Central Vermont has been authorized by the board of railway commissioners of Canada to place a bridge over the Yamaska river near Farnham.

The Chicago & North Western, it is reported, is considering the erection of a new station at Rapid City, S. D. The estimated cost of the structure is $100,000.

The Chicago, Milwaukee & St. Paul is considering the erection of a bridge across the Rock river at Janesville, Wis.

32-LEVER ELECTRIC INTERLOCKING PLANT, WESTERN MARYLAND RY.

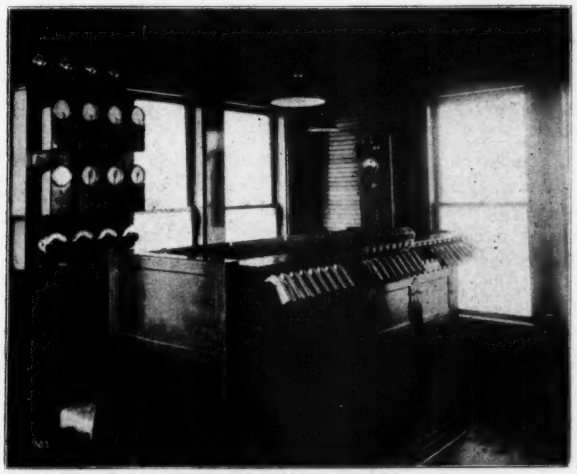
The Western Maryland Railway Co. recently put into service an all-electric interlocking plant, at the junction of the Georges Creek and Cumberland and the Pennsylvania State Line railways, at Cumberland, Maryland.

Track and Signal Layout.

Figure 3 shows the track layout, the location of all functions, the routing of signals, and line-up of tracks. All high signals, except the distant signals for 25 and 28, which are fixed blades, are Union Switch and Signal Co.'s style "S." They are semiautomatic stick signals, giving both two and three position indications in the upper right hand quadrant. Signals 1, 2, 28, 30 and 32 are three-position, while 3, 5, 6, 23 and 25 are two-position. The stroke of the blade in both cases is 90 degrees. All dwarf signals are two-position U. S. & S. Co.'s solenoid type, operating from 0 to 45 degrees in the upper right hand quadrant, and govern over the slow speed routes only.

Night Indications.

Long-time burner oil lamps furnish light for night indications, which are white for clear, green for caution, and red for stop. Marker lights are not used.



Interior of Tower, Interlocking at Georges Creek, Md.

The Interlocker.

A Union Switch and Signal Co.'s multiple unit electric interlocking machine controls the plant. It is a 32-lever frame, with 26 working levers and 6 spare spaces. Eighteen levers control 18 signals and 8 levers control 12 switches and derails.

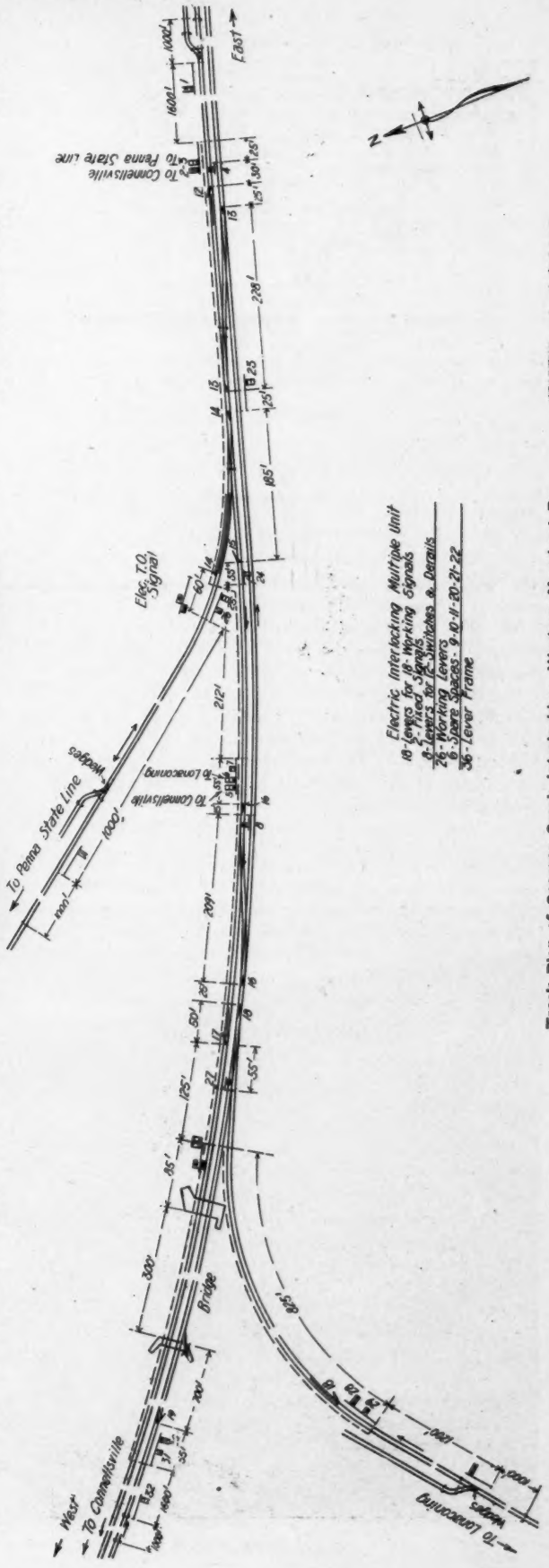
The interior view of the tower shows the machine complete in place. The first 8 levers are for signals; the next 3 are spare spaces. The next 8 levers are for the switches and derails. This set of levers includes the bank of lights mounted just above them. The following 3 spaces are spare. The next 10 levers are for signals.

The fact that each lever is an independent unit in itself and may be removed from the machine by taking out one screw, justifies the machine's name.

Lever Movements.

The lever movements are quite interesting. The first and last of three movements are longitudinal. The intermediate movement is in the arc of a circle.

All the working parts of a lever are attached to and supported by the frame "A," Fig. 1. The lever proper, "C," comprises a rod provided with a handle. The rod passes through a hole in a pivoted lever "B," the axis of the rod intersecting the axis of the trunnions at a right angle. This



Track Plan of Georges Creek Interlocking, Western Maryland Ry.

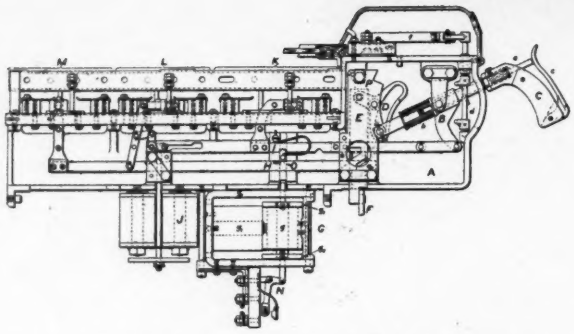


Fig. 1—Switch Lever with Detector Circuit Controller.

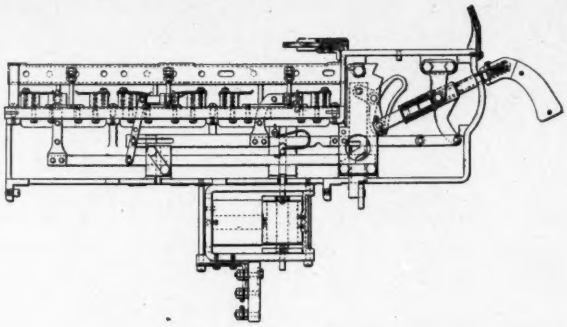


Fig. 2—Signal Lever.

method of support permits a longitudinal movement of the lever by allowing it to slide through the hole and an angular movement by permitting it to turn on the trunnions of the lever "B."

The function of link "D" is the same as that of the rocker on a mechanical machine, that is, to move the mechanical locking. In this case, the first longitudinal movement of lever "C" turns link "D" on its pivot, which in turn moves bar "E" and tappet "F," which effects the mechanical locking. The angular movement of the lever has no effect on link "D," since the roller moves freely in the slot of the link which is concentric with the trunnions on which the lever turns. The final inward longitudinal movement produced by the spring "b," moves the link "D," and the tappet still farther and effects the release of certain mechanical locking.

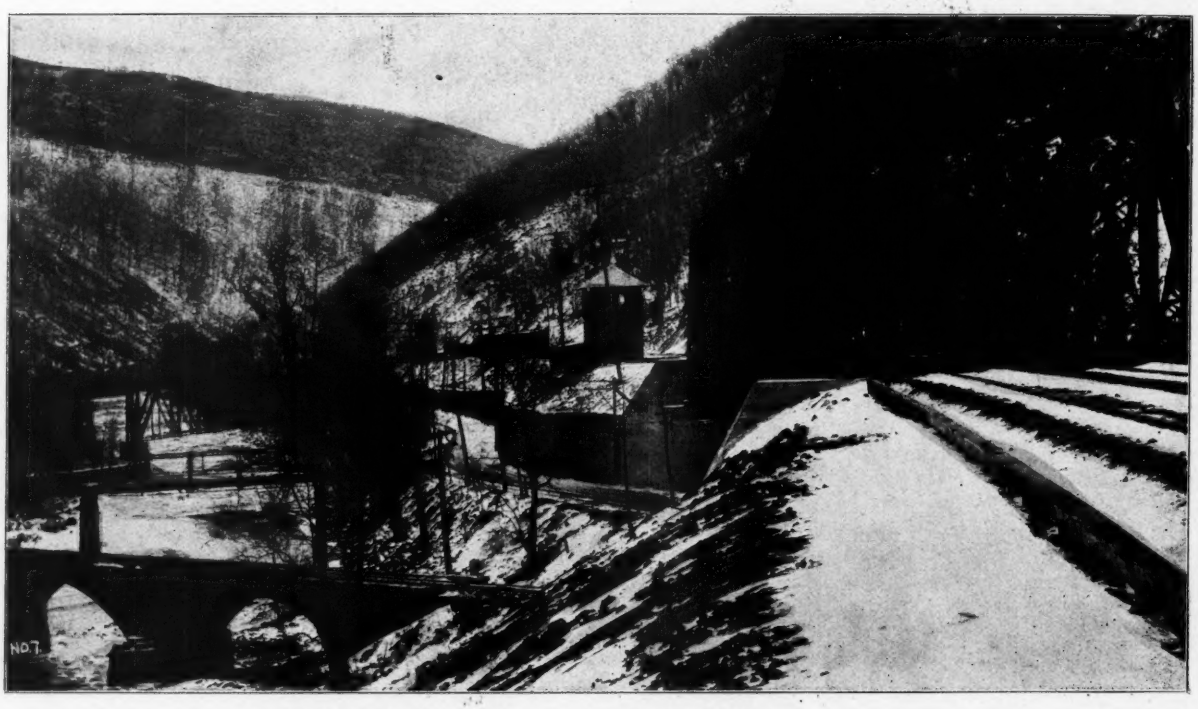
The thumb latch "C" is for the purpose of closing the circuit through the magnet "J," which releases the detector locking. This is effected through the rod "a," shaft "d," and contact spring "f." The latch arrangement keeps the circuit open under normal conditions, saves current and prevents overheating of the magnet "J."

The indication bar "H" receives motion from notches "e." "e_1" cut in the edge of bar "E." The motion of bar "H" corresponds to the motion of link "D" and, therefore, to the longitudinal movements of the lever.

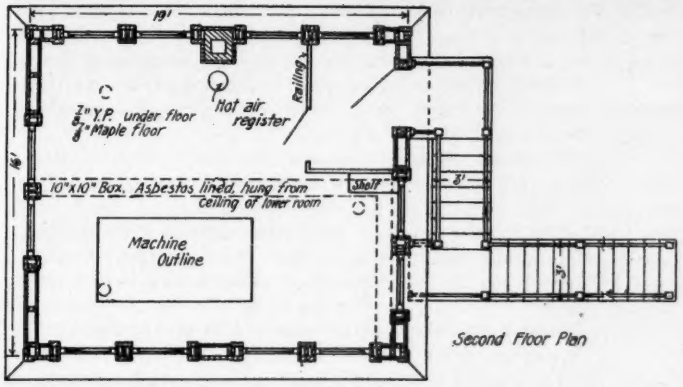
The notch cut in the indication bar "H" comes under the indication latch "O" when the bar is in its middle position. When the bar is in this position latch "O" drops into the notch and prevents the lever's final movement until the latch is picked up by indication magnet "J."

To insure that the latch drops into the notch, a cam on bar "I" will force it down in case the spring attached does not perform its function. The bar "I" is connected to the lever "B," which is moved by the rotational movement of the lever "C," during which movement the indication bar remains stationary. The uncut part of the bar "I" between the "V" notches is the cam which forces the indication latch down.

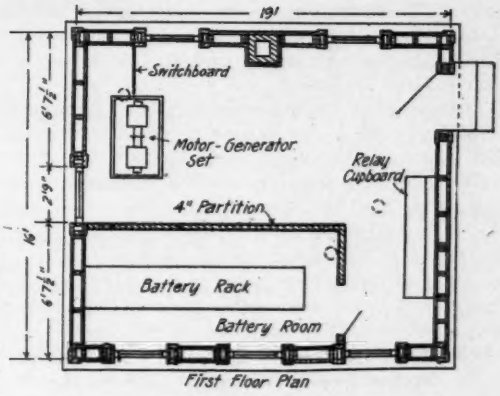
The controller K comprises four contact springs, two fixed rails, and two movable blocks. This controller is operated by the rotational movement of the lever and controls the operating circuits to the motor in one of its positions. One of the operating wires is put in connection with positive battery through the low resistance indication coil "g" and the other operating wire is connected to positive battery through the high resistance "g_1." The current in the latter



Geneal View of Interlocking Tower and Bridge Over Georges Creek.



Plan of Second Floor of Tower, Georges Creek Interlocking.



First Floor Plan.

circuit is limited too much by the high resistance to have any effect on the motor, which is governed by the much stronger current in the former. In the opposite position of the controller these connections are reversed.

The controller "L" is similar in construction to controller "K," but it is actuated by the preliminary and final movements of the lever. Its purpose is to close the motor stopping circuit and open the indication circuit when the lever movement is completed. The stopping circuit is also taken through the controller "N," actuated by the indication. The purpose of this is to close the stopping circuit only when it is needed and leave it open at other times. The controller "M" is a special and forms no part of the interlocking proper. By means of it, two circuits may be closed in either position of the lever.

The Indication Magnet.

The indication magnets "G" comprises two energizing coils, "g" and "g_1." The coil "g" is enclosed within an iron tube or shell which forms one pole of the magnet energized by coil "g_1." The other pole of the magnet resides at the two ends of the yoke, "g_3." Within the coil "g," and free to move in a vertical direction, is an iron core having flat iron discs, "g_2," attached to each end. These discs are the poles of another magnet energized by coil "g." If the direction of the current in coil "g" is such as to make the upper disc a north pole and the lower disc a south pole, and the direction of the current in coil "g" is such as to make the shell a north pole and the ends of the yoke south poles, the movable core will be pushed upward, but if the current in either coil is reversed, the core will be held down.

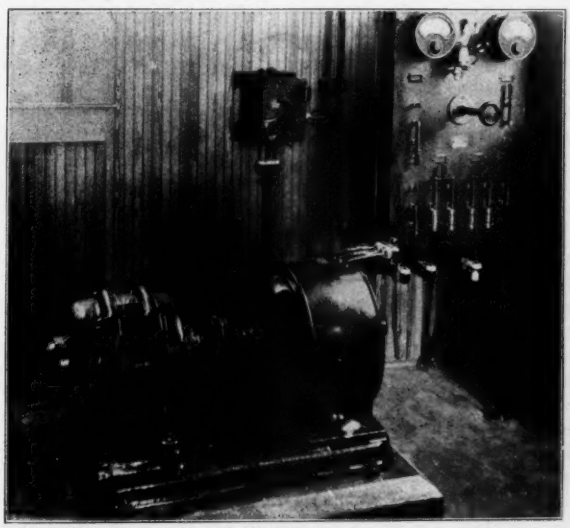
The coil "g," consists of a few turns of heavy wire and is energized by the operating current of the switch motor. The coil "g_1" has a large number of turns of wire and is energized by the indication current. The operating current through coil "g" has always the same direction.

During the movement of a switch a small current flows from the battery, through the coil "g_1" to the motor, but this is in a direction such that it holds the movable core down. After the switch movement is completed, and the driving current is switched over to one set of armature coils, current flows back in the opposite direction through the coil "g_1" and the core and indication latch are lifted.

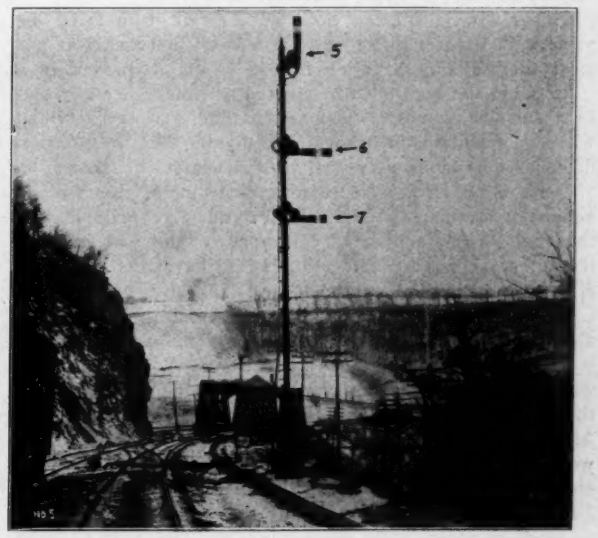
The signal lever is shown in figure 2, which is similar to the switch lever in figure 1, but it has an indication only in the normal position.

Power.

The power is received from a power company. The supply is furnished at 110 volts single phase, 60 cycle, for tower lighting and to operate the charging set, consisting of a 7½ H. P. motor direct connected to a 5 K. W. generator. A picture of this outfit with the power board is shown herewith. Fifty-five cells of chloride battery furnish power for the interlocking and a set of 7 cells of the same type of



Motor Generator Set.



Three Arm Home Signal.

battery furnish power to the low voltage circuits. The battery capacity is 200 AH, charged at the rate of 25 amps. The location of the power apparatus is shown in the first floor plan of the tower.

Track circuits are fed from 2 cells of gravity connected in multiple, which are housed in cast iron battery chutes.

Interlocking Tower.

The tower is a two-story wooden structure, 16 ft. x 19 ft.; it is 12 ft. 1 in. from top of foundation to ceiling joists of the first floor, and 23 ft. from foundation to ceiling of second floor. The pictures of the tower shown herewith give a very good idea of its appearance and the general condition of the surrounding country. The illustrations also show the method used for carrying the wires from the tower to the functions.

The interior view of the tower showing the interlocking machine, also shows the operating board and the indicator and annunciator group, with 4 clockwork time releases of the U. S. and S. Co's. type.

The wiring in the tower is in conduit and asbestos lined boxes. All soft drawn wire is Kerite. The leads from track are No. 9. From the line No. 14 in. cable; in chutes, No. 12 flexible; and local wire at locations is No. 14 single strand. All open wire on the pole line is No. 12 copper clad.

The tower lights can be fed from either the A. C. source of supply or from the storage battery.

Circuits.

The circuits for the control of all signals are typical for high voltage plants of this kind. The same is also true of the circuits for the control of switches and derails. The circuits for approach route locking used at this plant are the same as those used at other similar plants, and may be classed as typical for such layouts.

The plant was designed and constructed under the supervision of E. E. Bradley, signal engineer, to whom we are indebted for information and for the photographs and plans shown herewith.

The Maintenance of Way Department

DIFFERENT METHODS FOR HANDLING LABORERS OF DIFFERENT NATIONALITIES.

L. J. Olson.

These questions are very vital to the Western foreman and roadmaster: How to get men, how to keep men, and how to get the work out of men.

As to getting men I cannot speak with a great deal of authority, but I think some roads make a mistake in refusing deductions for board on the time roll. In the Western country a foreman can always pick up men that are floating through, and they will stay from two to three weeks, acting as a balance for the number of men in the gang. If the foreman was allowed to deduct these men's board, they could do a great deal of track work during the summer; but as it is no one cares to board this class of men without some kind of security.

Keeping a good gang depends upon the temperament of the foreman and the kind of laborers that he has. Some men make A-1 foremen for foreign labor, and are a flat failure in handling white labor, and vice versa. It would be well for the roadmaster to study his foremen in this respect and try to place them accordingly.

I have always noticed that the foreman who ruled his gang with an iron hand and allowed no liberties was the most successful in handling foreign labor. However, in a white gang the men must be treated as equals mentally and in a sociable manner. You always find that the foreman who can maintain the respect and dignity that the position demands gets along very well with all classes of labor.

There is an element in running extra gangs that will go against a foreman, if he is not careful. He must have a thorough understanding of his work, or he will speedily learn that he has lost his grip, and to have this happen is disastrous to both the foreman and the gang.

To get the required amount of work from a gang is probably the hardest problem for the foreman and especially when labor is as scarce as at present. A foreman must study his men; some men you have to horse right through the work, and be right on them every minute of the day. Again, there are others that if flattered will accomplish work, and there is another class, that if you lay the work out for them and leave them alone will work better.

Another good method in getting the work done is to have an understanding with the applicant. The average man seeking employment on the track thinks that he is only required to do so much work for $1.50 as compared with the man receiving $3 a day. Let him understand that if he agrees to do a day's work for $1.50 that it must be a day's work, judged by earnest effort and constant plugging rather than by the wages received. By using this method you are sure to eliminate the worthless at the very beginning and secure men who really mean business.

Always have the work planned far enough ahead so that the gang is always busy, and watch your track so that you can put your men to work for the whole day. Too many foremen spend much time in traveling from job to job. It not only wastes time, but it will spoil your gang, for it will be a hard matter to set them at a new piece of work and have them settle down to business.

THE LABOR SITUATION IN THE ROADWAY DEPARTMENT.

By A. M. Foote, Chief Clerk, Main. Dept., U. P. R. R.

For some years past, and more especially during the past six or eight months, all railroads are sounding the warning of efficiency and economy, in an attempt to counteract the effects of stringent and radical legislation. Although much progress has been made toward efficiency and economy in many departments that employ a large amount of labor, the organization of the maintenance of way department has long remained practically unchanged.

All railroads, especially trunk lines, have during the past fifteen or twenty years, made rapid strides toward the goal of "efficiency and economy" by providing cars that will carry twice the load as their predecessors and power to move twice the number of such cars as were formerly handled in a single train. Such rolling stock quite naturally called for 80-pound and 90-pound rail, to replace the old 60-pound and 70-pound, together with a rock or gravel ballast in lieu of dirt; all such betterments were made with one object in view,—to greatly increase the earnings, at a slightly increased cost of operation over the light rolling stock, light rail and dirt roadbed. Yet with these vast improvements we still find employed in the maintenance department today practically the same methods as were used twenty years ago, and the same class of labor, though possibly of a different nationality.

The track laborer of today is the roadmaster of tomorrow. Unless conditions materially change within the next few years, that will offer more encouragement, in the way

of better pay and improved methods of carrying on the work, which will induce intelligent labor to enter the service of a railroad in the roadway department, I predict the maintenance official will experience extreme difficulty in securing competent foremen and consequently efficient roadmasters. I believe in the old adage, as a rule, "a man who is paid well, will work well." You will say the track laborer of today is paid all he is worth, to which I agree, and I will further state at least 30 per cent. of them are paid more than they earn. But so long as it is decreed that the present wage shall be paid, as a general thing only those laborers will respond who are the overflow of southern Europe or the lowest type of a particular nationality, and these conditions will exist until wages are increased.

In addition to the low wages paid, there comes a time when the earnings fall off, or for some other particular reason the order to economize is flashed over the line, and then the track labor is the first to feel the effects of the order for retrenchment. The gangs are either reduced, or wages that are already too low are cut,—either of which causes dissatisfaction among the men, and a demoralization of your organization in the middle of the season's work, with the result that the track and roadbed suffer more than enough to counteract the retrenchment.

How will we remedy these conditions? The answer is simple,—Use improved methods and tools and pay higher wages, which are bound to attract the intelligent laborer, and last but not least, provide comfortable quarters for them together with considerate foremen. If we will follow this plan, then we will be able to go to these men in times when it does become necessary to economize to meet any emergency, and explain to them the situation that makes it necessary to only work them nine hours or to reduce their wages for a short time until business picks up. They have the intelligence to comprehend and I will vouch for it you will retain at least 95 per cent of the men, and thus avoid demoralization of your force. However, do not forget when earnings increase to increase their wages to the original rate, and if possible to a figure slightly in advance of the old rate as an appreciation of their loyalty.

Someone will say, "your argument is not practicable, if so it would have been adopted by the railroads long ago." From my observation I conclude that railroad managers are very reticent and skeptical in their views when it comes to a matter of improved methods of track maintenance, and seem to be very slow to adopt improved methods in the roadway department.

I have a concrete case in mind, which I will use as an illustration to substantiate the above statement, and to prove what can be accomplished by use of improved methods and equipment. One of the leading railroads made a successful experiment by combining the work of signal and track maintenance on a roadmaster's district, under the supervision of that roadmaster. At the same time the handcar was discarded and the gasoline section motor car substituted. The saving made is shown by the following detailed statement; and yet, although experience has proven this organization to be a success, as well as economical, it has not been universally adopted.

Monthly Comparison of Cost of Separate and Consolidated Organizations.

Separate Track Organization—Without Motor Cars.

Force.	Cost per Month.
1 roadmaster	$ 140.00
1 assistant signal supervisor	110.00
24 foremen	1,465.00
7 maintainers	525.00
Total	$2,240.00

Consolidated Track and Signal Organization—With Motor Cars.

Force.	Cost per Month.
1 roadmaster	$ 140.00
1 assistant roadmaster	110.00
11 foremen	825.00
11 assistant foremen	715.00
Total	$1,790.00
Separate organization, cost per month for supervision	$ 2,240.00
Consolidated organization, cost per month for supervision	1,790.00
Saving per month on supervision	$ 450.00
Saving per month on reduction in number of laborers account use of motor cars	624.00
Total saving per month account reduction in force	$ 1,074.00
Total saving per year account reduction in force	$12,888.00

Statement of Cost of Maintaining Track and Signals Under Separate Organizations as Compared With Cost of Maintaining Same Territory by Combined Organization.

Supervising force,—separate organization:		
1 roadmaster	$ 140.00	
1 assistant signal supervisor	110.00	
24 section foremen	1,465.00	
7 signal maintainers	525.00	
Total	$2,240.00	
Supervising force,—combined organization:		
1 roadmaster	$ 140.00	
1 assistant roadmaster	110.00	
11 section foremen	825.00	
11 assistant section foremen	715.00	
Total	$1,790.00	
Saving per month on supervision		$450.00
Saving per month on reduction of laborers account using motor cars	$624.00	
Saving per month in time going to and from work, account use of motor cars	707.72	
Saving per month in time of laborers account combined organization leaving foreman in charge, while other foreman is inspecting track and signals	353.93	
Total saving per month on laborers' time		$1,685.65
Total saving per month on labor		$2,135.65
Total saving per year on labor		$25,627.80
Cost of additional buildings that would have been required by separate organization	$17,754.00	
Less cost of additional buildings required to take care of combined organization	4,916.00	
	$12,838.00	
Expense of moving buildings to suitable locations and repairing same account combined organization	4,697.00	
Net saving on permanent investment in buildings	$8,141.00	
Interest at 4 per cent per annum on net saving in permanent investment		$325.64

Saving on investment in 24 hand cars that would have been required under separate organization	$648.00	
Saving on investment in seven 2-man motor cars for signal maintainers	945.00	
Total saving on cars	$1,593.00	
Interest at 5 per cent per annum on value of cars	63.72	
Annual saving on hand—and 2-man motor cars		63.72
Total gross saving per year		$26,017.16
Invested account combined organization:		
For 11 section motor cars, $3,850.00.		
Interest at 4 per cent. per annum on above investment	$154.00	
Cost per year maintaining above cars	440.00	
Cost per year to operate 11 section motor cars:		
Gasoline Oil	$660.00	
Lubricating oil	192.00	
Waste	30.00	
Total cost of operation	882.00	
Total per year for investment, maintenance and operation	$1,476.00	
For 11 2-man power velocipedes, $302.50.		
Interest at 4 per cent per annum on investment	$12.10	
Cost for oil and general maintenance	24.20	36.30
Total expense per year for equipment account combined organization		1,512.30
Total net saving per year account combined organization		$24,504.86
Total net saving per year, per mile of double main track with block signal equipment, for maintenance and operation		$258.00

The three important reasons for changing from the obsolete organization, and method of transporting men, tools and material between different points on the section, follows:

(1) The loss of time in transporting men back and forth between section headquarters and the place of operation, when hand-cars are used: by the hand-car method there is a loss of both time and energy. It cannot be expected that the gang which has pumped a slow moving hand-car against head-winds will start the day's work on the track with very much vigor, nor will they show energy in the afternoon's work with a prospect of pumping a hand-car several miles before arriving at home in the evening.

(2) The amount of time "killed" by laborers when left to themselves or when pumping the foremen over a section, as is necessary under the old organization, while foreman is inspecting track. Nearly all trunk lines require foremen personally to inspect the track on their respective sections at least three times a week. The foreman must either take the entire gang with him or leave a number of men to themselves while he is absent, which, in either event, results in practically nothing being accomplished by the gang during this inspection. This is especially true where foreign labor is used.

(3) The lack of sufficient force on any one section under the antiquated method for successfully and economically handling heavy work. This is due to the allotment of men per section being small, as the length of the section is restricted by the use of hand-cars and the allowance of laborers on a district is made practically on a mileage basis. Main line sections on trunk lines usually average four to six miles of single track or three to five miles of double track. During the summer season when the maximum force is employed, there are barely enough men in the section gang properly to line or surface track where heavy steel, hardwood ties, tie plates, and ballast are used. When the force is reduced, there are seldom enough men left to handle a full-length heavy-section rail, to say nothing of lining track, and when any heavy work is to be done, it becomes necessary to combine two or three section gangs, some of them pumping hand-cars six to nine miles. This plan results in no care of the track during the interim on the sections that have been robbed. The winter force on each section as a unit is of little use except to pump the foreman back and forth over his section, perhaps tightening a few bolts or tapping down a few spikes, there not being sufficient force to cover the whole section properly and gage, spike, or shim track.

The particular district referred to is divided into sections of nine and one-half miles, double track. On each of these sections there is a foreman in full charge of track and signals, with assistant foreman and 12 to 15 laborers during the summer season, and 5 to 7 laborers during the winter months. On each of these sections gasoline section motor-cars are used with push-car trailers capable of transporting 15 to 20 men and full complement of tools. This motor-car and push-car trailer are also used in distributing ties and other material over section as well as in picking up ballast to be used in fattening the lean places in roadbed.

A hand-power velocipede is also provided for the use of each foreman in making track and signal inspection, as experience has proven a thorough inspection of track conditions and signal apparatus cannot be made by the use of motor cars. No matter how conscientious the inspector may be, he will unconsciously, if not intentionally, travel over his section at a rate of speed that will not permit of proper inspection. Therefore, it was considered advisable to equip each section with a hand-power velocipede for use in making daily inspection. This has resulted in considerable saving in the difference in cost of the two types of cars, and at the same time has secured a more perfect inspection and consequent higher efficiency in track and signal maintenance.

It has been proven that this organization, together with the improved methods, overcomes the three principal difficulties previously mentioned, namely:

(1) The men are transferred to or from any point on a 9½-mile section in 30 or 40 minutes, without the necessity of them working their passage, which fact alone creates considerable satisfaction among the men.

(2) The men are under the constant supervision of a foreman, as when the foreman is absent from gang on inspection, the assistant foreman is then in charge.

(3) There are a sufficient number of men on each section at any time properly to handle any ordinary maintenance work.

In general, more frequent and more careful inspections are made, and both the signals and track are maintained in better condition than under the former separate organization, and at a greatly reduced labor expense. This plan has eliminated any friction between men of different organizations, as there is but one organization, and the foreman on each section reigns supreme.

I believe the organization can be further improved. How-

ever, the district where this experiment was made has maintained the high standard for which the road has a world-wide reputation, very much more economically than by the former antiquated organization, and yet as above stated, the road in question is slow to universally adopt the organization, thus verifying my assertion that railroad managers do not appear to possess the progressive spirit, when it comes to maintenance of way matters.

I believe the track laborer's job should be made as attractive as possible, and he should be educated to show respect for his job as does the office man. The man who has no respect for his job, cannot have much respect for himself. If he respects his job, he will take pride in his work, and put forth his best licks to "make good" with his employer. His work will show merit. The employer will see results, and should appreciate the efforts of the employe, and make appropriate reward for the efficiency shown.

LABOR IN GEORGIA.

By J. N. Newsom.

In the beginning of this article allow me to say that different conditions exist in different localities, and I shall give my views on this great question to cover only the conditions that are present in my locality.

Here on the Georgia railroad our track labor is mostly negroes, and these are laborers that are not in very great demand except for railroad work. The reason for this is, the farmers and public corporations pay more per day and allow more liberties than are allowed by the railroads of the South; therefore, the white labor is all employed by these agents. We are allowed to work 8 men yearly and pay them $1.00 per day of 10 hours, furnish houses and grant passes occasionally.

We have 4 white men, called apprentices, which receive $1.25 per day on each division. These are picked men and have certainly earned this grand name and price.

The foreman is allowed to employ his own labor and has full control of laborers. If the foreman finds a man in his gang who is shirking his duty, he is allowed to give the man his time and dismiss him from the service. But under the above conditions it is impossible for us to obtain good labor. I believe 10 good laborers can and will do as much work as 18 or 20 poor laborers, the kind we have to contend with here.

Now, my idea and plan for us to obtain good laborers and to hold them is as follows: First, to pay the laborer a fair price for his work. I believe it would be beneficial to both the railroad and to the laborer for the company to allow foremen to grade the labor. In this vicinity I think the following scale would be satisfactory: First-class labor, $1.35 per day of 10 hours; second-class labor, $1.10 per day of 10 hours; apprentices, $1.50 per day of 10 hours. By this plan every laborer will work to get his pay increased to the limit, and by having competent foremen all dissatisfaction can be easily adjusted with fair play and good treatment. I know we would be enabled to hold good labor.

My experience on section and extra gangs indicates that track maintenance is the mainstay of the railroads of today. It takes skilled labor and a man with brains as foreman to keep 8 miles to each section in such condition that the traveling public can glide over this land of ours on two bright streaks of steel at the rate of 70 to 90 miles per hour without accident.

Foremen should remember that the laborers under him are human and have feelings like himself, and can not in this day be driven to do work; we have to lead them to work by fair pay and good treatment. The day is past when the overbearing authority of the foreman was felt, for the simple reason that men will not now work for such a foreman. Men have a limit of endurance and this is governed by the localities wherein they may labor. Here in this part, from May 15 to October 1, we have great heat, and men out at work in it can not hold the same speed every day. Some days these laborers are not feeling good, and the way they feel certainly has an effect.

Down here we have the old time lever section car. It weighs something like 800 pounds and would hardly run down the inclined roof of a section house. Our labor has to pump this car from headquarters every morning to the place of work and back home in the evening. When we get to our place of work the men are already tired from that back-breaking work; then they know the same task confronts them in the afternoon, and they slack up on their speed to get rested for the return trip. Now if the railway officials would only notice this and furnish each section crew with a good railroad motor car of say 8 or 12 horsepower, our laborers would be fresh when we arrived at the scene of work and more willing to work. This would also be an inducement to offer for obtaining and holding plenty of good labor for railroads. I believe all laboring men appreciate a little kindness. Foremen will find that they can get more work and better work from his laborers by treating them kindly. I don't intimate by this that we should allow laborers to shirk their duty. But in years past it was like this: "I am boss and you do just what I say;" and this was followed by cursing and sometimes by a blow with the pick handle. We foremen must remember how when we labored with the pick and shovel, at times we would be almost ready to quit, but just then perhaps our boss saw our condition and did not rush us, but allowed us a little opportunity to cool off. "Do unto others as you would have others do unto you."

First and foremost the railroads will have to increase the pay of labor. It is not my aim to agitate labor. But this true saying expresses my position: "You cannot get something for nothing." However, since railway officials claim that, under present conditions, it is impossible to increase the pay let us as foremen treat our laborers fair and square, but demand a fair day's work in return. Perhaps in the future we shall have a gang of first-class laborers and be running over our eight-mile sections 25 miles per hour on a sure-enough motor car.

The St. Louis, Brownsville & Mexico is considering constructing about 30 miles of sidings.

The St. Louis, Iron Mountain & Southern will build a passenger station at Lake Charles, La.

The Southern Pacific Co. is said to be planning to construct a steel bridge in San Francisco, Cal.

The Willamette Pacific, Marshfield, Ore., is said to have made application for permission to construct a bridge across Coos Bay.

The Kansas Southwestern during the winter will replace the Howe trusses over the Chickasha river at Drury, Kan., with steel girders.

The Atlantic Coast Line will build a station at Winter Park, Fla., and it is stated that within 30 days the road will award the contract for the improvements to the station at Waycross, Ga.

The Baltimore & Ohio has ordered from the American Bridge Co. 200 tons of steel for a highway bridge.

The Canadian Pacific is said to have plans for the construction of a steel and concrete bridge across the Pitt river at New Westminster, B. C. The structure will cost approximately $75,000.

The Chicago & Alton has moved into its new portion of the new union station at Joliet, Ill. The Chicago, Rock Island & Pacific will move in about October 15, it is said.

The Great Northern is reported in the market for 3,500 tons of bridge steel.

With The Manufacturers

EXHIBIT OF THE BRIDGE AND BUILDING SUPPLY MEN'S ASSOCIATION.

The Bridge and Building Supply Men's Association held an exhibit of appliances adjacent to the convention hall. The following firms exhibited:

American Hoist and Derrick Co., St. Paul, Minn.—Transparencies of American ditcher in bridge work, represented by F. J. Johnson and W. O. Washburn.

American Valve and Meter Co., Cincinnati, Ohio.—Poage automatic water columns and automatic cut-off valves, represented by J. T. McGarry and F. C. Anderson.

Asphalt Ready Roofing Co., New York.—Protection and arrow brand roofing, Hudson brand asphalt felts, represented by H. H. Husted and W. A. Hemenway.

Barrett Manufacturing Co., New York.—Coal tar products, prepared roofing, bridge waterproofing paint and tar-rock sub-floor construction material, represented by L. P. Sibley, H. B. Nichols, E. J. Caldwell and W. S. Babcock.

Carey Co., Lockland, Ohio.—Asphalt roofing, asphalt shingles and roofing matrial, represented by N. S. Kenney, D. R. Warfield, O. A. Bigler and Richard Kelly.

Chicago Pneumatic Tool Co., Chicago.—Pneumatic tools and Rockford motor car, represented by C. E. Walker, J. W. McCabe, E. A. Barden and Thomas Aldcorn.

Clapp Fire-Resisting Paint Co., Bridgeport, Conn.—Samples of fire-resisting paint, represented by W. A. Clapp.

Detroit Graphite Co., Detroit, Mich.—Samples of graphite and photographs of applications, represented by Tom Wyles, D. C. Smith and J. J. Hogan.

Dickinson, Paul, Inc., Chicago, Ill.—Ventilators for stations and buildings, represented by J. A. Meaden and A. J. Filkins.

Dixon, Joseph, Crucible Co., Jersey City, N. J.—Photographs picturing applications of Silica graphite paint, represented by H. A. Neally and N. A. Housten.

Eastern Granite Co., New York.—Samples of Granite and Tisbest roofing, represented by H. Henning, W. F. Sachs and G. B. Skinner.

Fairbanks Co., New York, literature, represented by F. C. Mattern and J. R. Meginnis.

Fairbanks, Morse & Co., Chicago, literature, represented by C. W. Kelly, F. H. Douglas and J. L. Jones.

Flintkote Manufacturing Co., Boston, Mass., literature, represented by P. J. Everett and C. D. Townsend.

Forest City Paint & Varnish Co., Cleveland, Ohio, literature, represented by W. B. Wood.

Johns-Manville Co., H. W., New York.—Regal and asbestos samples, asbestos stucco, represented by J. E. Meek, G. A. Nicol, W. H. Lawrence and H. G. Newman.

Lehon Co., Chicago.—Roof-rite roofing and Per-bona insulating papers, Tex-proof saturated burlap and Roof-rite reinforced cotton duck roofing, represented by Tom Lehon.

Milburn Co., Alexander, Baltimore, Md.—Acetylene flare lights for night construction work, represented by C. R. Pollard and F. W. Mallen.

National Roofing Co., Tonawanda, N. Y.—Samples of "Security-wide-weld roofing" and asphalt shingles, represented by D. A. Bonitz and A. Clarke.

Patterson Co., W. W., Pittsburgh, Pa.—Pulley blocks and tackles, represented by W. W. Patterson, Jr.

Richards-Wilcox Manufacturing Co., Aurora, Ill.—Railway hardware, door hangers and rollers, represented by W. D. Jameson.

Standard Asphalt and Rubber Co., Chicago, represented by Norman Malcolm and C. V. Eades.

The Texas Co., New York.—Samples of insulating papers and asphaltum, represented by W. E. O'Neill, G. A. Huggins, F. K. Dorrance and L. F. Jordan.

Wadsworth-Howland Co., Chicago, represented by E. E. Allen.

Webb Manufacturing Co., F. W., Boston, Mass.—B. & M. combination railroad closet, Webco unions and valves, represented by G. H. Ayer.

U. S. Wind Engine and Pump Co., Batavia, Ill., literature, represented by L. E. Wolcott and C. E. Ward.

At the annual meeting the following officers were elected: President, H. Henning, Eastern Granite Roofing Co.; vice-president, J. A. Meaden, Paul Dickinson, Inc.; secretary, H. A. Neally, Jos. Dixon Crucible Co.; treasurer, D. A. Bonitz, National Roofing Co.

HAND CAR MOTORS.

Of the many appliances that have come into use in the maintenance work of railroads in the past ten years, nothing has been of more help to roadmasters, track supervisors, signal men and other officers whose work was scattered over miles of track, than the gasoline motor car, making these men independent of regular train service and keeping them in closer touch with the work than was possible prior to the use of these cars.

These cars demonstrated early in their use that while they were valuable adjuncts for the practical railroad official, they were sometimes dangerous on account of the high speeds of which they were capable and in a good many cases they were abandoned on account of the death or serious injury of the men using them. They showed their value for section and other maintenance work, but their high cost made their saving problematical; their delicate mechanism and complicated parts made breakdowns common, and showed the desirability of using only skilled operators to handle the cars.

Railway officials generally conceded the need of some kind of power to replace manual labor for propelling section cars, and they also saw the value of motor section cars in concentrating section forces in time of trouble, but realized that to meet their needs the gasoline car must be safe, reliable, simple, durable, and its first cost as well as maintenance charges must be low; that while strong it must be as light as consistent with good practice. There came a demand for a power unit which could be applied to present equipment, and this is the need which the "Jerry Boy" engines were designed and built to fill, and that they are succeeding is shown by the more than twelve hundred outfits that have been put in service in forty states, and Canada, in the past year.

The Associated Manufacturers' Co. came into the gasoline engine manufacturing field with the idea that by making every part of a gasoline engine perfectly interchangeable and by making every possible part an automatic machinery, it was possible to make engines of the best materials, and with accurate workmanship, and sell them at a price as low as any similar rated engine on the market, regardless of quality.

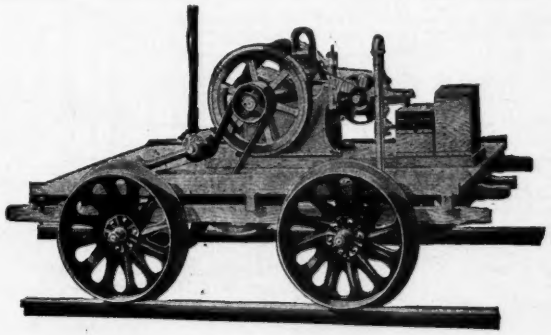
Some two years ago the attention of this company was drawn to the motor hand car engine and the conclusion was reached that the proper thing to do was to manufacture and market an engine complete with attachments that would fit any standard hand or push car, in fact, make the motor hand car a practical necessity rather than the luxury it had been before.

After exhaustive experiments, about one year ago, this company put on the market what they called the "Jerry Boy" hand car engines, offering them in two sizes, viz: 1¾ H. P. and 2¼ H. P.

It was realized fully that to get selling results and to know positively that the engines were filling the place for which they were intended, it was necessary to get them into the hands of the actual user by the shortest possible route, and therefore the first engines were sold direct to section foremen on easy monthly payments.

The manufacturers in putting this engine on the market endeavored to make the engine as nearly "fool proof" as possible, made it exceedingly simple, and as a consequence it is readily installed and operated by men who have had no previous gasoline engine experience.

This engine is what is known as a slow speed engine, doing its work at a speed of only four hundred and fifty revolutions per minute, which means reliability in operation, few if any repairs, and long life. It is made of the best of materials, using fifteen per cent steel in grey iron castings, drop forged steel crank shafts and connecting rods (the latter with phosphor bronze bearings), hardened and ground tool steel piston pins, solid steel crankshaft pinions; in fact, throughout the entire engine only the best materials and workmanship are used. All parts are well proportioned



and amply strong to do the work intended. The four cycle principle is used in this engine and this company claims that these hand car engines show a marked economy in gasoline over all engines of the same power in similar service.

In deciding upon the speed at which the car should run, the opinion of a number of prominent railroad men throughout the country was solicited and they unanimously advised that a speed of twelve to fifteen miles per hour was ample for all practical purposes, and therefore these engines leave the factory set to propel the car at this speed.

As it was thought a water-cooled engine would give trouble under a great many conditions that are ordinarily met in railroad operation, the air-cooled type of engine was chosen. A very efficient system of fan cooling keeps the cylinder cool in the hottest weather and under the severest service, and in cold weather there is no danger of freezing and there is no water to boil away when the engine is compelled to work to its capacity for long periods of time.

The car is driven by a belt direct from the engine to a pulley on the driving axle of the car. In order that the engine may be started before starting the car and that car might be stopped without stopping the engine, a very simple and efficient belt tightener was designed and made a part of the outfit, thus making a very flexible and simple drive that freely compensates for all inequalities of load and track.

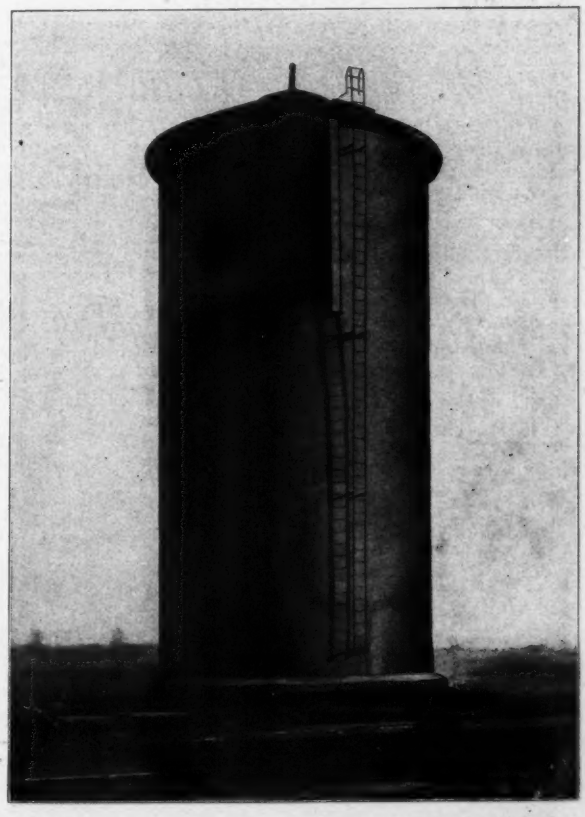
In service the engine is covered by a framework attached firmly to the car with hinged cover and doors on the operating side of the engine. These are closed when the engine is running, affording seat room and giving more room on the car than when it was equipped with levers, it being nothing uncommon for an ordinary hand car equipped with the engine to carry a dozen men and tools.

The Associated Manufacturers, Waterloo, Ia., manufacturers of the "Jerry Boy," have recently filled an order from the Missouri, Kansas & Texas for a carload of these engines for service in Texas, after some twenty of these engines had been purchased by the section foremen on that line.

REINFORCED CONCRETE WATER TANK AT AUSTINBURG, OHIO.

The reinforced concrete water tank built for the Pennsylvania Lines West at Austinburg, Ohio, in late autumn and early winter of 1909 was the first tank of its kind to be built by the Steel Concrete Construction Co., Pittsburgh, Pa. This company owns and operates the "McCoy Patent" metal tank forms and methods of construction.

The tank, which has a capacity of 54,000 gallons, has an inside diameter of 23 ft. and a height of 16 ft. The tank proper is supported by a circular concrete tower 34 ft. high from ground to bottom of tank, with a 23-ft. inside diameter



Reinforced Concrete Tank on the Pennsylvania at Austinburg, O.

and a 25-ft. outside diameter at the ground line, tapering to 24 ft. 4 ins. outside diameter at bottom of tank proper. The tower below the tank is used for a store and pump room. The foundation was originally designed to be 33 ft. in diameter and 3 ft. thick, reinforced with square twisted bars, but this design was modified during construction.

In excavating to the proper depth for the foundation, it was found that a bed of quicksand 8 ft. thick lay within 18 ins. to 2 ft. below the bottom of excavation. With

only this thin layer of clay intervening between the bottom of foundation and the quicksand it was considered advisable to secure a better foundation. For this purpose 15-ft. piling were driven in circles 3 ft. on centers, cut off 6 ins. above the bottom of excavation; 96 piles were used in the foundation. The concrete footing on these piles is 33 ft. in diameter and 4 ft. thick, the concrete used being a 1:2½:4½ mixture. The reinforcement for footing consisted of ½-in. bars placed radially in bottom and bars bent to concentric circles placed upon these.

The tower walls are 12 ins. thick at the ground line and 8 ins. thick at the tank bottom, reinforced with ½ in. bars near outer surface, 2-ft. centers horizontally. The only vertical reinforcement in the tower consists of twenty 1-in. pipe used for hoisting forms and keeping horizontal reinforcement in place. A plain concrete interior tower to support tank bottom and enclose piping is 5 ft. square inside for a height of 10 ft. above floor line, with walls 10 ins. thick; above this the wall is circular, 5 ft. in diameter, tapering to a thickness of 7 ins. at the tank bottom. The shaft formed by this interior tower contains the discharge and supply pipes. A door at the bottom gives access to pipes and values.

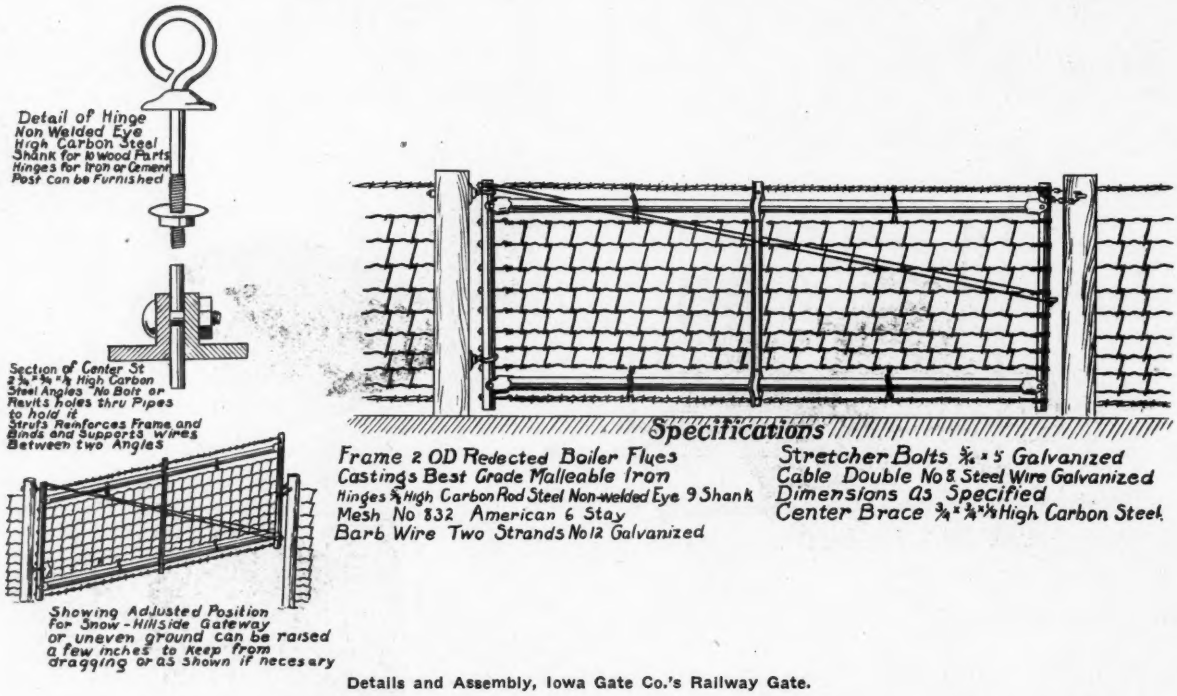
The tank bottom is of concrete 15 ins. thick at the wall and 1 ft. thick at the center support. The reinforcement consists of thirty-two 8-in. 18-lb. I beams placed radially from tower wall to center support afforded by interior tower. One inch bars, 4 ft. long, are placed between I beams and four concentric rings of ½ in. bars 6-in. centers near side wall act as distributing bars. The connection of pipes to bottom of tank is made by means of a casting 6 ft. 2 ins. in diameter and 10 ins. deep, concreted in the floor. The pipe flanges are bolted directly to this casting, thus making the connection absolutely watertight.

The walls of tank proper are 8 ins. thick at bottom and 6 ins. at top. The reinforcement consists of vertical ½ in. bars, about 12-in. centers and ½ in. bars horizontal bent to radius of tank near outside of wall, the spacing varying from 3 ins. at bottom to 12 ins. in top portion.

The tank is covered with a wooden roof and equipped with a steel ladder, and a water depth indicator.

The tower and tank walls were built with the use of McCoy Patent self-supporting sheet steel forms, in sections 5 ft. 6 ins. high. A complete description of these forms, with methods of operation, including illustrations, was given in the September, 1912, issue in a description of a tank built by the same company at Sir Johns Run, W. Va., for the B. & O. Ry.

The construction work was begun on Oct. 1st, 1909, and after much trouble with foundation the pouring of vertical walls was started and the tank finished on Dec. 5th. During this time 29 days were lost on account of freezing weather and non-delivery of materials. The last concrete to be poured was the actual tank bottom. At present the practice is to pour the tank bottom at the same time the wall secion at that level is poured, but this being the first tank built by the company no satisfactory method of doing this had been evolved. It was thought that seepage would take place at the joint between floor and walls, but by careful work a watertight joint was secured.


Detail of Hinge
Non Welded Eye
High Carbon Steel
Shank for Wood Parts
Hinges for Iron or Cement
Post can be Furnished
Section of Center St
Steel Angles No Bolt or
Rivits holes thru Pipes
to hold it
Struts Reinforces Frame and
Binds and Supports Wires
Between two Angles
Showing Adjusted Position
For Snow - Hillside Gateway
or uneven ground can be raised
a few inches to keep from
dragging or as shown if necesary
Specifications
Frame 2 OD Redected Boiler Flues
Castings Best Grade Malleable Iron
Hinges ⅝ High Carbon Rod Steel Non-welded Eye 9 Shank
Mesh No 832 American 6 Stay
Barb Wire Two Strands No 12 Galvanized
Stretcher Bolts ⅝ × 5 Galvanized
Cable Double No 8 Steel Wire Galvanized
Dimensions as Specified
Center Brace ¾ × ¾ × ⅛ High Carbon Steel

Details and Assembly, Iowa Gate Co.'s Railway Gate.

Immediately after pouring the last concrete, the weather turned cold and the concrete was subjected to severe cold, with no damage as afterwards demonstrated. On account of danger of collapse of the old wood tank the Pennsylvania R. R. Co. desired to install the piping and use the tank as soon as possible. On Feb. 10th, 1911, the piping and roof were completed and water turned into tank, which has given excellent service ever since.

The Steel Concrete Construction Co., Berger Bldg., Pittsburgh, designed and constructed the tank described herein.

THE IOWA RAILWAY GATE.

The accompanying illustrations show an interesting type of railway right-of-way gate as well as several features connected with its manufacture. This gate was originally built for farm purposes and has been used for years with the greatest of success in that application. In the farm gate the best quality of high carbon steel tubing is used for the

framework and the filling is made up of heavy galvanized wire fencing.

For railway right-of-way fencing a method was devised for manufacturing a gate which for economy in first cost and efficiency in service appears to be a masterpiece of ingenuity. All railways have constantly on hand quantities of discarded locomotive boiler tubes which have only a scrap value. These boiler tubes are purchased by the Iowa Gate Company, carefully cleaned by means of a rattler and

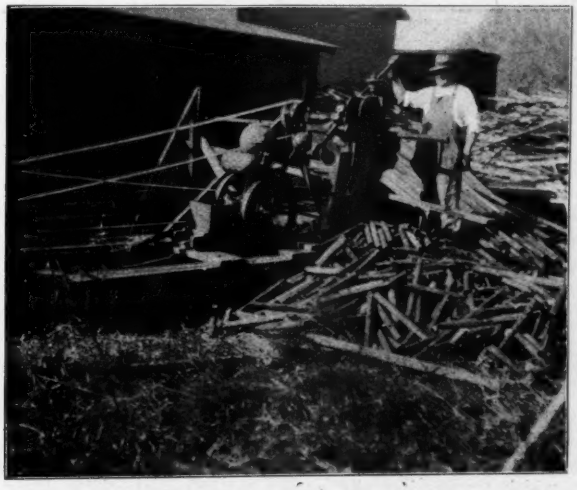
Tubes as Delivered for Gate Manufacture, Iowa Gate Co.

scraping, sawed down to length or spliced out as the needs require, and used in place of the expensive steel tubing. The result is a gate of excellent appearance, long lasting qualities, and of practically no maintenance cost; while the first cost is reduced to a minimum.

These gates are carefully painted black to prevent rusting. Heavy wire fencing is used as a filler and the gates are finished with barbed wire of home manufacture, at both top and bottom. Malleable castings are used at the joints and an adjustable wire tension member holds the gate in any desired position for opening over snowdrifts or other obstructions, or for application on side hills.

The wire mesh is arranged with flexible connections to the tubing frame, although it is fastened on all four sides and at the center brace, to prevent breaking. The drawing shows the details of this design. The hinges are of five-eighths inch round steel with ten-inch shanks. These hinges cannot become disconnected from the gate in shipping or service, while the strength of the detail is such as to preclude the possibility of breakage.

An interesting feature in the preparation of the old boiler tubes for use in the manufacture of the gates is the method

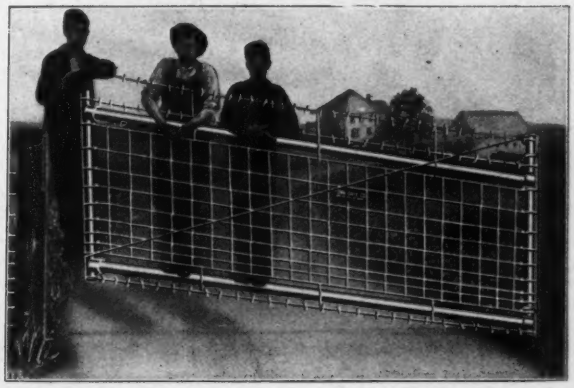


Machine for Cutting Boiler Tubes to Length.

used in splicing lengths too short for use as a unit. The ordinary weld cannot be used on account of the distance of the joint from the tube ends and also because the welded joints do not give the resistance to right angle strains offered by the remainder of the tube. In the place of a weld a shrunk joint is used. This joint is made by swaging one tube end down for a distance of six inches. The other tube end is then heated and the two are driven together. In this manner a shrink fit of great strength is obtained. A swaging machine which turns out the work with great rapidity is used in the process.

The Iowa gates are used on a great many railways to the exclusion of the wooden type. Experience has shown that this policy results in a surprising saving both in stock claims and in actual maintenance costs. The first cost of the gate described is so low as to be practically negligible when comparisons in length of life and maintenance are made. There

Tube Rattler for Clearing Boiler Tubes, Iowa Gate Co.



The Iowa Gate Raised for Swinging Over an Obstruction.

Finished Boiler Tubes for Manufacturing Iowa Gates.

Plant of the Iowa Gate Co., Cedar Falls, Ia.

seems to be no argument against the metal gate which cannot be satisfactorily answered in its favor. The ingenious method of obtaining double service from locomotive boiler tubes, while perhaps not individually interesting to the maintenance of way engineer, is of great importance to the railway organization as a whole.

The photographic reproductions serve to show the extent and several processes of the manufacturing facilities of the plant of the Iowa Gate Co., which is located at Cedar Falls, Iowa.

BUDA SECTION MOTOR CARS.

The Buda Company has recently made a number of improvements in the Buda No. 19 motor section car.

The motor is a two cylinder, 4 cycle double opposed air cooled motor, which is rated at 8 H. P. The engine is protected by a 3 piece motor case; the crank case, cam case, and the oil pan.

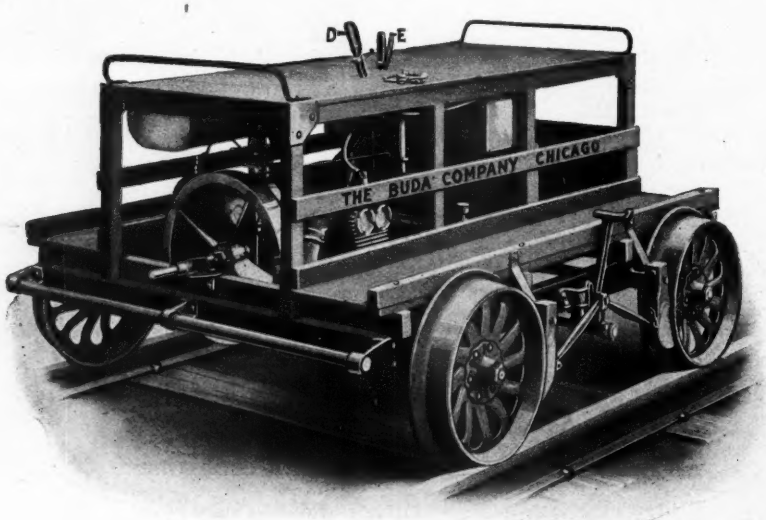
The oiling system consists of a positive feed gear pump which begins to operate and deliver oil as soon as the motor is started. The oil is drawn from the well in the oil pan and pumped through pipe leads into the false bottom of the oil pan where it lubricates all parts by splash, being picked up by small projections on the connecting rods as they revolve. The oil is maintained at a constant level, thereby providing a steady splash and insuring all parts being properly lubricated. Oil overflowing from the false bottom in the oil pan passes back to the oil well and in this way there is no waste, consequently the engine is a very economical one in its consumption of oil. The gear pump is entirely enclosed and is driven directly by small helical gears from the engine shaft.

The transmission is illustrated herewith. It is of the single friction disc type, the parts lettered being (A) driving disc; (B) friction wheel; (C) friction wheel countershaft.

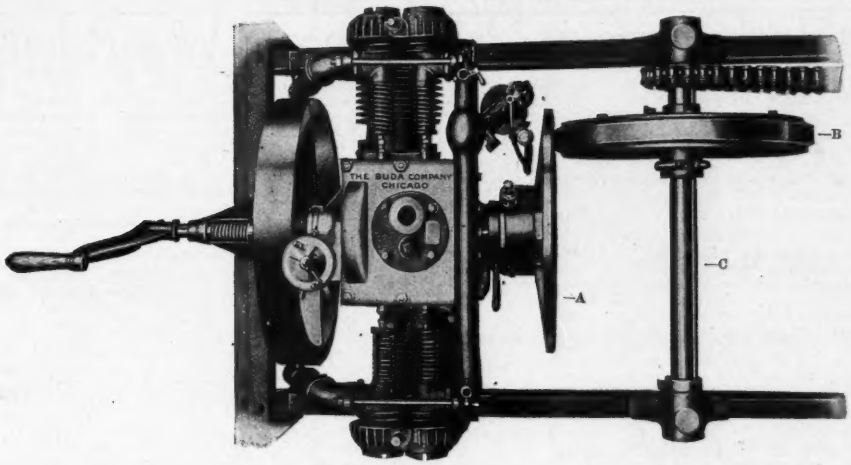
This transmission, it is claimed, possesses many advantages; it permits of operating the car at a wide range of speeds in either a foward or backward direction, is particularly adapted for working under severe conditions such as operating on grades or hauling heavy loads, is very simple and requires no expert handling. and, it is claimed, is very durable and positive in its operation.

The engine is of the free running type, being started by cranking independent of the car, similar to an automobile engine, and the car is put in motion under its own power by bringing the driving disc "A" in contact with the friction wheel "B," which is accomplished by means of a lever located on top of the car seat. The lever which controls this transmission is the one indicated by the letter "D" in the illustration of the complete car and it is pulled backward, thus carrying the driving disc "A" back on a steep pitch screw. This lever is equipped with a locking latch which drops into a ratchet, thus holding the driving disc "A" firmly in contact with the friction wheel "B." The transmission is disengaged by releasing the locking latch when the driving disc "A" is automatically carried away from the friction wheel "B," thus cutting off the power from the driving axle of the car.

The friction wheel "B" has a lateral motion on its countershaft "C" across the face of the driving disc "A" and the variation in the speed of the car is obtained by shifting the friction wheel "B" to various locations on the face of the driving disc "A." For the reverse direction of the car the friction wheel "B" is shifted to the opposite side of the center of the driving disc "A," the variation in speeds being available in either a forward or backward direction with equal facility. The friction wheel "B" is located at the extreme outer diameter of the driving disc "A" for the maxium car speed and shifted in toward the center for the lower speeds. This friction wheel "B" is shifted by means of a lever designated by the letter "E" in the illustration of the car, which travels laterally across the car seat. This lever is equipped with a locking latch which drops into milled re-



Buda No. 19 Section Car.



Details of Friction Drive, Buda No. 19 Section Car.

cesses in the shaft on which it travels, thus holding the friction wheel "B" firmly in any given position.

This style of transmission is an especially important feature where heavy grades are encountered or the car is to be used for carrying heavy loads or hauling a push car loaded with railroad ties or other material, for the reason that the full power of the engine is available at all times, regardless of the speed at which the car may be running. The car speeds are controlled entirely in the transmission, thus permitting the engine to run at its normal revolutions per minute. When the car is required to perform severe service, the friction wheel "B" can be located at the inner diameter of the driving disc "A," thereby reducing the speed of the car to the minimum but increasing its traction and giving it greater ability for doing heavy work.

The frame of the car is built of automobile pressed steel channels, riveted together, forming the chassis of the car. The engine and transmission are carried on a sub-frame of the same material which is supported by the main frame of the car, making a firm and substantial foundation for the power plant. This frame construction, it is claimed, gives the car requisite strength for severe service and yet is light enough so that the car can be easily removed to and from the track. The body is equipped at both ends with wrought iron handles for handling the car.

The Buda No. 19 car described herein is manufactured by The Buda Company, Railway Exchange, Chicago.

NEW BELLE ISLE MOTOR.

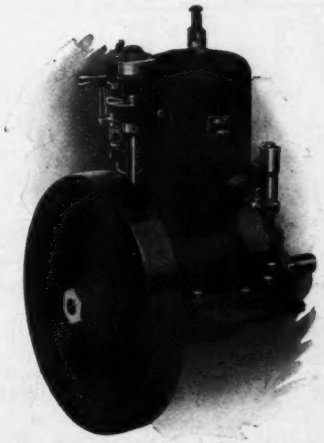
The Concrete Form Engine Co., Detroit, Mich., has designed a new 4 to 5 H. P. Belle Isle Motor which has several noteworthy features.

The general construction and quality of the new Belle Isle motor remains the same but the outside appearance has been made much more attractive. Slight changes have been made which have added greatly to the convenience of the operator. The most important of these changes is an elevated geared timer, which brings the spark control within easy reach of the operator. This timer is so constructed as to give a long, clean contact at every revolution and makes the reversing of the motor absolutely positive. A slight change has been made in the construction of the fly wheel, resulting in a perfectly balanced motor. All fly wheels are fitted to crankshafts on a taper fit and locked in place with a large locknut.

A double, sight feed lubricator has been installed, one connection of which distributes the oil directly on the piston and the other connection delivers the oil to the crankcase so that it is dropped directly on to the connecting rod.

The weight of the motor remains the same, at approximately 125 lbs. Complete with all engine accessories, sprockets and chain and reverse gear, the combined weight is less than 200 lbs. The construction of the motor is such that it can be readily installed on the standard section car by any foreman with the tools which he may have at hand.

At an additional charge of $24.00 a high tension magneto



Improved Belle Isle Motor.

ignition system can be supplied, which eliminates entirely the use of batteries, switch and spark coil.

The extreme simplicity of this motor insures its successful operation in the hands of the inexperienced user. There being no small or delicate parts to require attention or wear, makes the maintenance of this engine nearly negligible.

Extensive improvements are now nearing completion to the passenger and freight terminals of the Cincinnati, Hamilton & Dayton at Cincinnati, O. The passenger station, which is of brick construction, having two stories and basement, has been transformed into a thoroughly modern terminal and remodeled throughout. In addition to these improvements, the inbound freight house, just west of the passenger station, has been overhauled.

The Hocking Valley, it is said, will start work on November 1 on the proposed dock and terminal at Toledo, Ohio. The work will cost about $2,000,000.

The Houston Belt & Terminal has awarded the contract to the American Construction Co. for the construction of a 110-ft. Strauss bascule span, with an 80-ft. approach span. The estimated cost is $60,000.

Recent Engineering and Maintenance of Way Patents

MAIL CATCHING AND DELIVERING DEVICE.

1,042,256—W. T. O'Hara, Spokane, Wash.

The device herein described has an arm journaled to rotate on a vertical axis, a segment positioned to support the arm throughout the major portion of its travel but stopping short of one extremity, and means permitting the arm to drop over the extremity when reaching such extreme of movement.

LOCK FOR BASCULE BRIDGES.

1,042,238—H. C. Kruse, Chicago, Ill.

The combination with a lift or bascule bridge, of a pair of locking devices therefor, one on each side of the roadway, each of the devices comprising a toggle joint, one of the arms of the toggle joint being pivotally attached to a fixed support, and the other arm being provided with a shoulder arranged to engage a portion of the bridge, means for flexing both of the toggle joints simultaneously, the means comprising a rod having a right-handed screw at one end and a left-handed screw at the other, a block arranged to be engaged by each of the screws, guide members for each of the blocks, and links connecting each of the blocks with the central portion of the toggle joint.

GUARD DEVICE FOR RAILWAY CROSSINGS.

1,042,102—C. E. Francisco, Woodston, Kan.

A guard for railway crossings comprising a base adapted to be secured to the ties, with side and end walls securely fastened together, the casing being arranged between the rails and the opposed edges of the crossing bed, one of the side walls being adapted to abut against the web of the rail and disposed under the tread of the rail, means for securing the side wall to the rail, a vertically movable guard member mounted in the casing and normally disposed so that its upper face is flush with the top of the tread of the rail, and coil springs mounted in the casing and bearing against the under side of the guard member to hold it in a normal position.

CROSS TIE.

1,042,071—A. J. Bates, Chicago, Ill.

A railway tie comprising a pair of pedestals made of plastic material and spaced apart to support the rails, a skeleton box-like frame embedded in each pedestal adjacent to the surface thereof, and a pair of parallel one-piece trussed metal structures of skeleton form forming parts of the frames and reinforcing and connecting the pedestals.

RAILWAY SIGNAL.

1,042,028—J. W. Page, Quitman, Ark.

In a railway signal an electric motor, a circuit therefor, arranged to be closed at a remote point, a box in which the motor is mounted with its shaft disposed in a vertical position, the box being mounted in its top with an opening, a vertically disposed staff mounted in the opening and connected at its lower end to the shaft of the motor, a stand mounted on the top of the box and formed with openings for light to shine therethrough on opposite sides of the staff, a signal flag projecting horizontally from and secured to the staff and designed to be swung over to close one of the openings upon the actuation of the motor, a cable secured at one end to the staff, and a trip lever connected to the other end of the cable.

RAIL ANCHOR.

1,041,996—M. E. Hagen, Paul Smiths, N. Y.

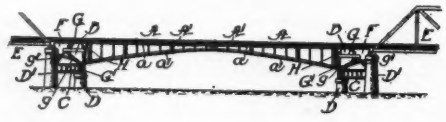
The herein described rail anchor comprises a shank having a fixed jaw at one extremity and oppositely disposed lugs at its other extremity; a movable jaw having an opening shaped to be passed over the last named extremity of the shank and its lugs; and a third member consisting of a cam head having a similarly shaped opening through its body and on its outer face a pair of cams adapted to engage behind the lugs, and a lever projecting radially from the head, bent in its body, and rounded at its outer extremity.

RAILWAY SIGNAL.

1,041,988—A. H. Fargo, Newark, N. J.

In a railroad signal, a semaphore arm having oblique end edges, and means for illuminating the arm comprising a long vacuum tube and means whereby electric current is caused to pass through rarefied gas in the tube and render the same luminous, the tube being carried by and angled to outline the oblique end edges, the top edge and the bottom edge of the arm.

1,041,885



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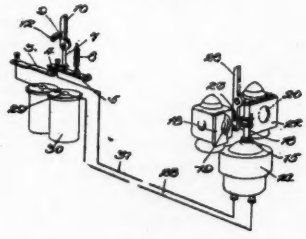

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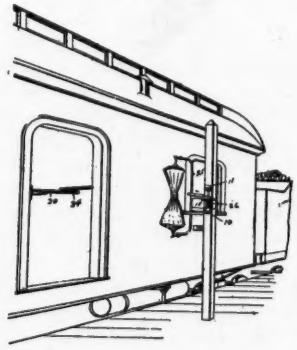

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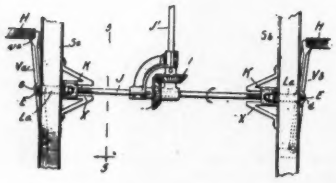

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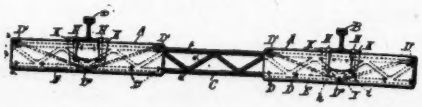

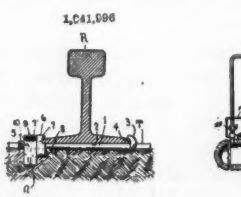

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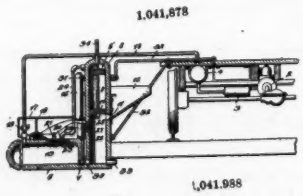

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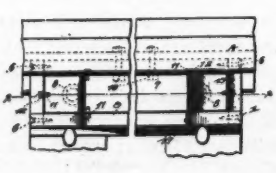

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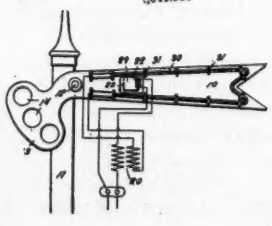

STATEMENT AS TO THE OWNERSHIP AND MANAGEMENT OF RAILWAY ENGINEERING AND MAINTENANCE OF WAY, IN ACCORDANCE WITH ACT OF CONGRESS, AUGUST 24TH, 1912.

Railway Engineering and Maintenance of Way is published monthly at 431 South Dearborn St., Chicago, Ill.

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(Signed)
WILLIAM E. MAGRAW, PRESIDENT.

Sworn to and subscribed before me this 1st day of October, 1912.
(Signed) Robert R. Grieg,
Notary Public.
(My commission expires Oct. 26th, 1915.)

New Dixon Railroad Booklet

We have just prepared a booklet treating of the various Dixon graphite products for use on the railroad. The entire Dixon railroad line is treated of and all other matters excluded—this booklet is of interest only to the various mechanical railroad departments.

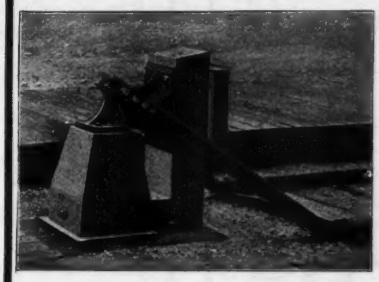
The application of dry graphite for lubrication, the use of Dixon's graphite greases, Dixon's Silica-Graphite Paint, crucibles, facings, crayons, etc., is all included in this booklet—a total of 40 pages. There is bound to be some matter to interest you here.

We have tried to make our booklet attractive in appearance as well as interesting to read, and to this end have included views taken of railroad stations and yards, stretches of track, signals, bridges, etc.

Write for copy of this booklet by number 187 R. R.

Joseph Dixon Crucible Co.

Jersey City, N. J.



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Noted for Simplicity, Strength and Lasting Qualities. Adapted to all positions.

Mechanical Mfg. Co.,
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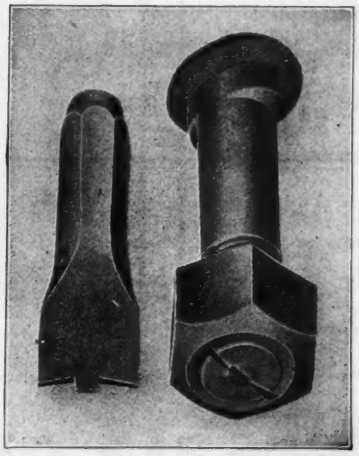
THE CLARK NUT LOCK



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350 pages; fully illustrated, 5⅛x7½ inches. Price, $1.50, net postpaid.

Practical Switch Work

By D. H. LOVELL
Division Superintendent Pennsylvania Ry.

An Instructor and Guide for Roadmasters, Section Foremen and Construction Foremen

This book is presented in a very clear manner, which is at once simple, thorough and practical.

The contents include chapters on General Turn-outs; Stub and Split Switches; Analysis of Curves; and a large number of tables for the quick and correct construction of any switch.

Cloth, 174 pages; 4½x6¼ inches. Price, $1.00, net postpaid.

Maintenance of Way Standards, by F. A. Smith, M. E., C. E. - Price, $1.50
Standard Turn Outs on American Railroads, by F. A. Smith - Price, 1.00
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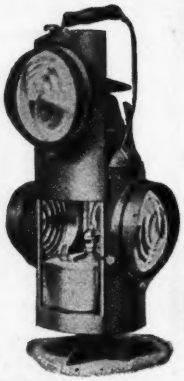

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SWITCH, ENGINE,
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CHIMNEYLESS BURNERS
for one day and long-burning service

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New and specially equipped factory enables us to fill large orders promptly and at fair prices.

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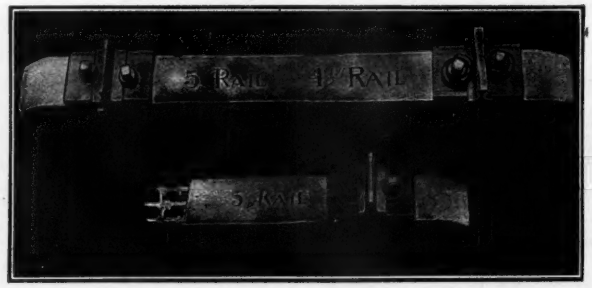
JOSEPH M. BROWN, Representative.

The Universal Concrete Tie

Note carefully the details of the spiking device and the peculiar "V" shape of the base of the Tie at the center, which insures an absolutely perfect alignment, obviates spreading of the rails, or the slewing of the track. The heavy hardwood cushions preserve the rolling stock as well as the tie; last for six to fifteen years, and are then almost instantly removed by the loosening of the screw spikes by one man.

The Percival Patents

In use under various Trunk Line Railways for five and six years past.



The above cut illustrates the Universal Concrete Tie.

For further facts and full evidence, address the

UNIVERSAL CONCRETE TIE COMPANY

1408-9 Whitney-Central Bldg.
NEW ORLEANS, LA.

Trains are running sixty miles an hour over these ties, and have been so running for more than five years, yet they have had no repairs, realigning or even tightening of the spiking devices.

The reinforcement of our ties consists of four corrugated bars, the approximate length of the tie, and varying in size from 1-2 in. to 1 in. These are secured in proper shape by electro-welding the heavy binding wires. The truss core of the tie thus forming a complete unit within itself.

The best tie for terminals, because it is permanent.

The best tie for yards, because it is fire proof, rust proof, and will hold rails true to gauge.

The best tie for main lines and heavy traffic, because it is absolutely dependable under all conditions, as we can show in roads using them.

NON-CORROSIVE wooden water pipe is manufactured by The Michigan Pipe Co.

The pipe is steel banded, as shown. The steel bands are protected by a coat of imperishable asphaltum cement. The pipe is strong as steel with the resiliency of wood.

Some advantages of "Michigan Wood and Steel Pipe:

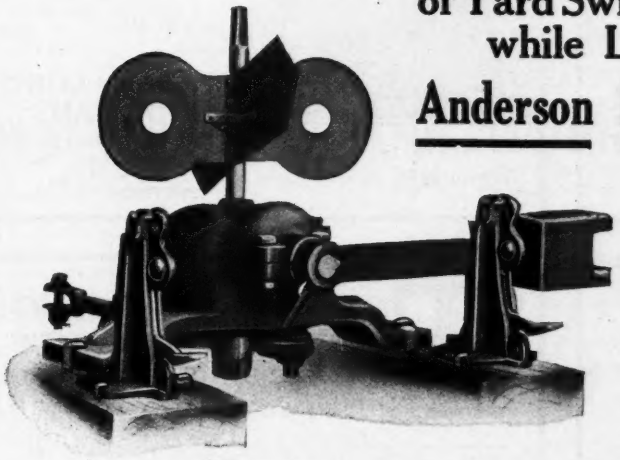
Will not corrode. — Protects water from freezing. — Less friction than metal pipe. — Withstands vibration without loosening the joints. — Withstands water hammer without bursting. — Withstands Hydraulic Pressure of 200 lbs. per sq. inch.

Many other advantages explained in our catalogue—write for it.

This pipe **lasts indefinitely,** and can be made as **strong as desired.**

THE MICHIGAN PIPE CO., Bay City, Michigan

$16\frac{2}{3}$ CENTS Maximum Maintenance Cost of Yard Switches that are Run Through while Latched if you use the Anderson Economy Switch Stand



This stand for yard switches, is provided with a special 3 way crank arm made of malleable iron. This 3 way crank arm is designed that when switch is run through, one of the arms to which the switch is connected will shear off, without damage, to any part of the switch mechanism.

The switch can be quickly placed in order by connecting the rod to one of the other arms. When the three arms are destroyed a new three way crank can be applied. These are furnished at 50 cents each. This feature is not new.

Over 30,000 Economy switch stands with this special 3 way crank, in service on many railroads.

Nonbreakable cranks are furnished for main line switches.

Full Details and Description of This Switch Stand in Our Catalogue. Write for It

MANUFACTURED EXCLUSIVELY BY

THE AMERICAN VALVE AND METER COMPANY

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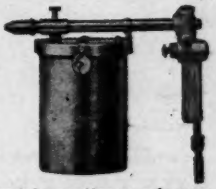

to decrease expense in your painting department by spraying your lacquers, bronzes, enamels, varnishes, japans, etc., and for painting iron fences, buildings, bridges, etc. We manufacture hoods, spindles, lathes, filters for use in connection with our air brushes.

A postal telling us what you paint will bring this information gratis.

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Also Manufacturers of the "Peer" Exhaust Fans and Blowers

Economy is the Best Policy

An installation of Water Softeners by one of our railway customers not only enabled it to increase its average freight train haul by 40% more cars but to make a saving of 15% in its fuel cost per train load mile over the previous year.

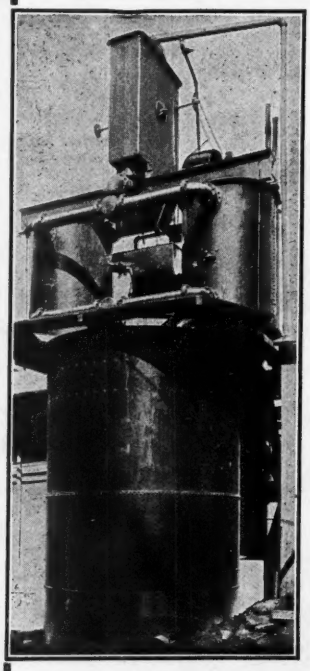
Over one-third more cars moved and 1600 tons less coal consumed in doing it should appeal forcibly to every railroad man whose locomotives traverse bad water districts.

Write us for a copy of the railroad report upon which the above statement is based.

American Water Softener Co.
1015 Chestnut Street, Philadelphia

"A laborer can operate the American"

Solving the Alkaline Water Problem



Lord's Water Softening Apparatus for Special Cases

Every locomotive water supply station—getting its water from a different source—is a separate water purifying problem for the railroad man.

Foaming troubles are a universal complaint, and it is only by our unusually long experience of 50 years in the water purifying business and a special study of conditions in alkaline water districts that

LORD'S WATER PURIFYING CHEMICALS

have attained such a remarkable success.

They completely remove any existing scale and prevent its formation.

Tell us your conditions, and let us suggest a remedy. This will not obligate you in the least. Write us now about it.

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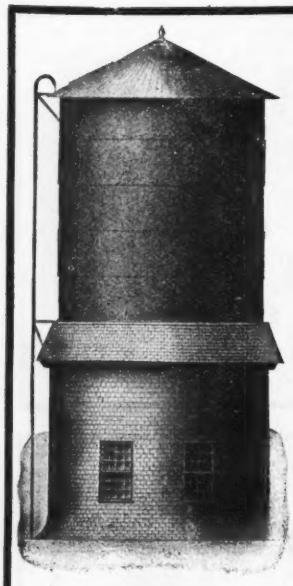

SOFT WATER
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PURE WATER

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PRESSURE
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PITTSBURGH FILTER MFG. CO.
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IF YOU can find an error in the November issue of ***The Monthly Official Railway List,*** you will be given a year's subscription to ***Railway Engineering*** or your subscription will be extended one year.

See Offer on Page 113, November Issue of

The Monthly Official Railway List

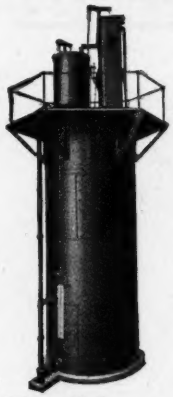
The Johnson Car Replacer

Range and Capacities of the different types are as follows:

	If Not Over	Capacity.	Throat Opening	Wt. Each
Type M for rail 12 - 45 lbs.	3½ inches high	20 Ton Locomotive	2 ins.	30
Type C for rail up to 65 lbs.	4½ inches high	30 Ton Locomotive	2½ ins.	90
Type B for rail up to 80 lbs.	5 inches high	50 Ton Locomotive	3¼ ins.	110
Type A for rail up to 100 lbs.	5½ inches high	80 Ton Locomotive	3½ ins.	145
Type Z for rail up to 100 lbs.	6 inches high	100 Ton Locomotive	3½ ins.	165

The Johnson Wrecking Frog Company
CLEVELAND, OHIO

STEEL TANKS AND PLATE WORK



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FAVORABLY KNOWN FOR

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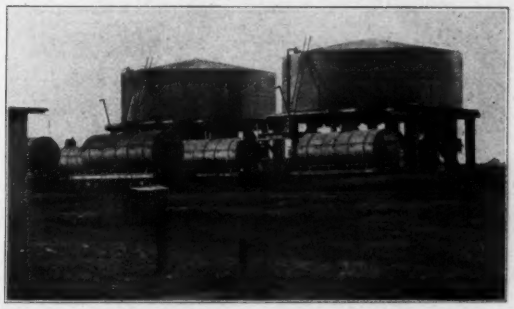

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THE BARTLETT-GRAVER WATER SOFTENER HAS NO EQUAL

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Maintenance vs First Cost — For One Gate Opening

The relation of maintenance to first cost as effecting final net returns from a given investment, is frequently not fully appreciated by railway officials who continue to use wooden gates. Why specify and buy four or five cheap gates to fill the same opening in ten years' time, spending the railroad's money (at least $25.00)—also claims paid for "stock killed"—also "continual repairs" on a gate that will not keep stock off the right-of-way, when for one-fourth of the amount railroads can purchase an American Self-Lifting High Carbon Steel Galvanized Gate that will settle the cost and expense for that opening forever? Note advantages of American Railway Gates.

"Drags up Never Down." Horse High. Bull Proof. Fool Proof and Hog Tight. Painted or Galvanized.

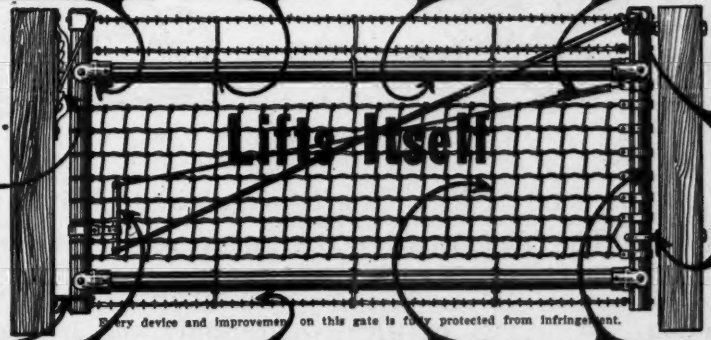
Flexible Steel Couplings. Four flexible steel couplings allow the American Railway Gate to "give" without wrenching or twisting when stock crowds against the gate or loaded wagons strike it. No other gate has this flexible-coupling principle.

Connections. Flexible connections between the wire covering and steel frame turn and slip, but cannot be loosened by hard usage.

Tubing. Tubing is so strong no extra bracing needed. It is 2 inches in diameter; no other gate tubing is as large or strong.

Helical Lifting Spring. This powerful helical lifting spring is like the springs used on the best farm machinery in strength and quality. The coil wire used is baked, tempered in oil and galvanized, and will stand six times the strain of the gate.

Ratchet Lock. This ingenious ratchet-lock-and-loop locks the gate down close to the ground, or adjusts the gate when the ground is rooted up by hogs or "hove up" by frost, or when snow is deep.



Bolted Caps. Caps are securely bolted to the frame. All couplings, caps and attachments, like the gate frame itself, are cold-rolled steel, pickled and limed—the highest quality steel made.

Fork This hog-yard Fork holds the lower part of gate firmly; stock cannot wrench it out of place.

Hinge Lock-Nuts. Hinge lock nuts enable you to hang gate plumb, even if the post is out of plumb or uneven. Also 7-inch leeway for the hinge allows gate to rise or settle with freezing or thawing of ground.

Every device and improvement on this gate is fully protected from infringement.

Self-Lifting Equalizer. This automatic equalizer raises the end of the American Railway Gate when the ratchet lock is released. You do not have to lift the gate at all; it lifts itself. No other gate made has this self-lifting principle.

Hog Tight. Barbed wire close to ground and low position of bottom tubing makes it impossible for hogs to root under or through.

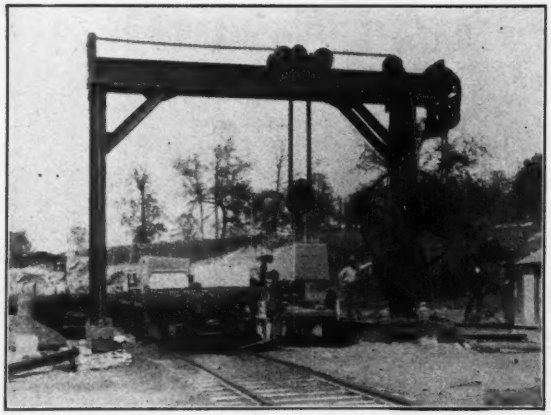
Wire Mesh. Note the closely woven wire mesh. Only finest quality American Steel & Wire Company standard wire mesh is used.

Ratchet Stretcher System. The horizontal wiring is tightened and kept rigidly in place by a ratchet stretcher system—the only true principle of tightening the heavy mesh hog wire. Even tension is insured by tightening each wire separately.

THE GATE THE FARMER WILL "KEEP CLOSED"—SO EASY TO OPERATE. WE CONTRACT AND SHIP EVERYWHERE. WRITE US FOR PRICES, CARLOAD OR LESS.

American Farm Gate Company, R. R. Dept., Kansas City, Mo., U. S. A.

H. L. GOODWIN, Vice-President and General Manager



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is an inexpensive and durable machine for handling all heavy loads from car or wagon with just one or two men. Being equipped with safety appliances, it practically eliminates all danger to the men.

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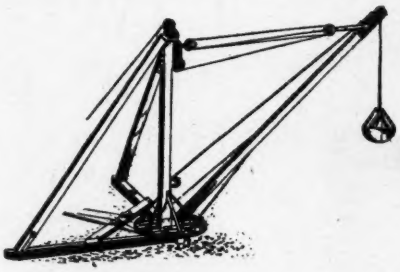

We can furnish machinery which will absolutely fulfill your requirements, at minimum cost. :: :: ::

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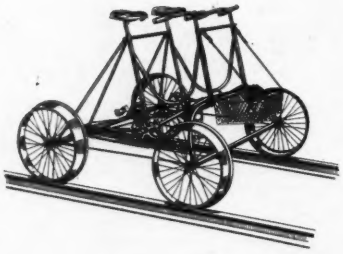

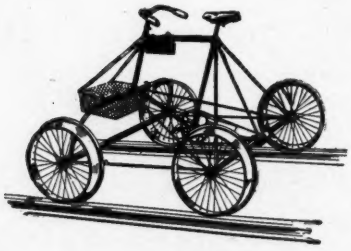

Light Inspection Cars are the Strongest and Lightest running known. The fact that we constantly receive repeat orders is proof absolutely that our cars are giving entire satisfaction. We shall be pleased to supply you with our new catalog that tells all about them.

LIGHT INSPECTION CAR CO.
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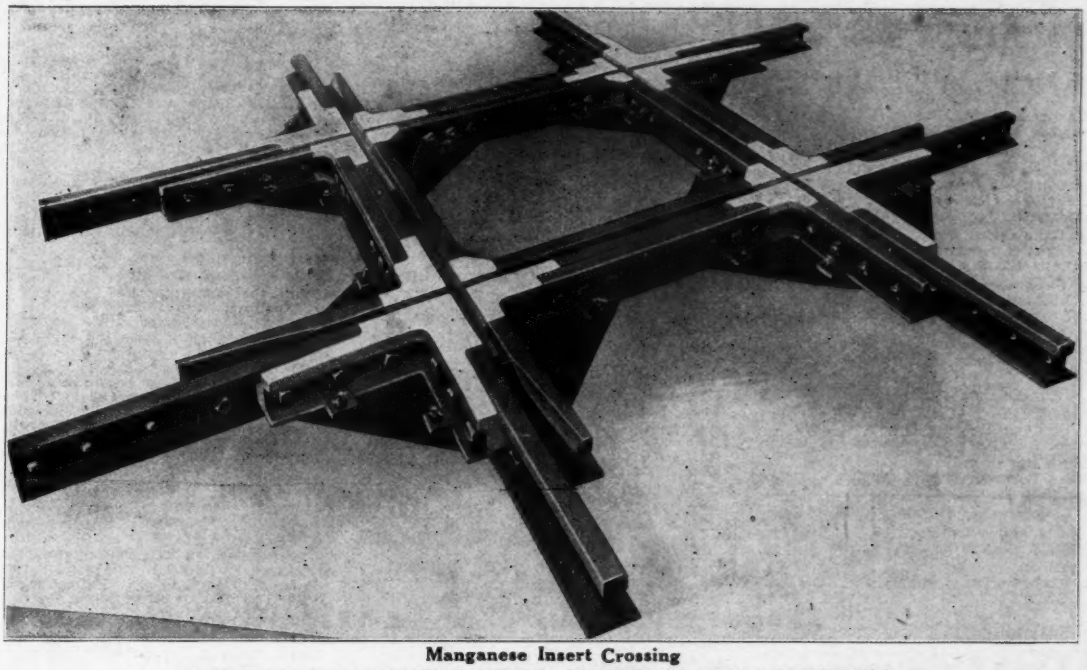
30 years' experience goes into our products. Our manganese stands up under severest test.



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ORDER OUR MANGANESE STEEL AND *FORGET YOUR CROSSINGS*

THE FROG SWITCH & MANUFACTURING COMPANY, CARLISLE, PENNA.

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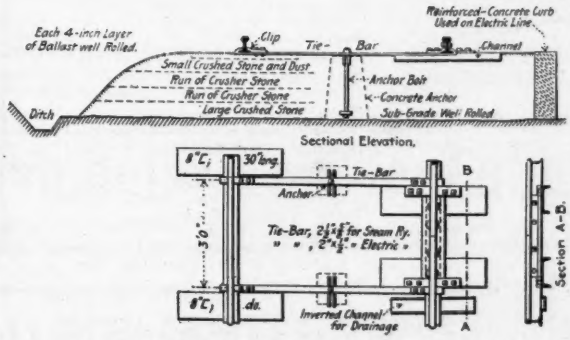
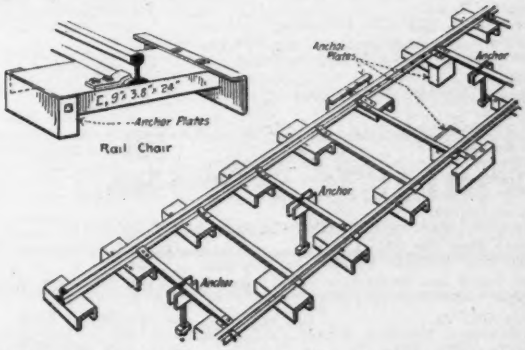


Track Construction with a watertight bed of rolled stone ballast.



Track Construction for very heavy traffic, used in connection with heavily rolled bed of broken stone.

A reinforced compacted monolithic bed or permanent way is a support for the rails and rail chairs. The chairs may be considered under the head of tie plates. My bed represents both the ballast and wooden ties combined. A bed constructed on my plan will answer every condition required of both, and more too. The alignment is permanently maintained, as well as surface and gage. It will admit of the use of anti-creeper appliances. There is a scrapping value in the steel after being used. The bed will not settle out of sight in the soft ground and be lost. It is practically water-tight, and has a tendency to prevent the settlement of embankments. It can be constructed to carry wheel loads of 30,000 lbs. each at maximum speeds.

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Hubbard & Co., Pittsburg, Pa.

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Seelig, R., & Son, Chicago.

Switch Lanterns.
Gray, Peter, & Sons, Boston.

Switch Rods.
Weir Frog Co., Cincinnati, O.
Ramapo Iron Works, Hillburn, N. Y.

Switches and Switch Stands.
American Valve & Meter Co., Cincinnati, O.
Atlas Railway Supply Co., Chicago.
Cincinnati Frog & Switch Co., Cincinnati.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

Switchboard Adjusters.
Weir Frog Co., Cincinnati.

Tank Cars.
Wm. Graver Tank Works, E. Chicago, Ind.

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Wm. Graver Tank Works, E. Chicago, Ind.
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Dilworth Porter & Co., Pittsburg.
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Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Track Jacks.
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Track Layers.
Hurley Track Laying Machine Co., Chicago.

Track Laying Cars.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

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Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
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Hubbard & Co., Pittsburg, Pa.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Wyoming Shovel Works, Wyoming, Pa.

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Nichols, Geo. P., & Bro., Chicago.

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Electric Ry. & Equip. Co., Cincinnati, O.

Turntable Tractors.
Nichols, Geo. P., & Bro., Chicago.

Turntables.
Nichols, Geo. P., & Bro., Chicago.
Philadelphia Turntable Co., Philadelphia.

Valve Grease, Graphite.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

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Glidden Varnish Co., Cleveland, O.

Velocipede Cars.
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Gray, Peter, & Sons, Boston.

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Lord, Geo. W., & Co., Philadelphia, Pa.

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Lord, Geo. W., & Co., Philadelphia, Pa.

Water Softeners.
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Booth, L. M., Co., Chicago.
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Lord, Geo. W., & Co., Pittsburg, Pa.
Pittsburgh Filter Mfg. Co., Pittsburg, Pa.

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Michigan Pipe Co., Bay City, Mich.

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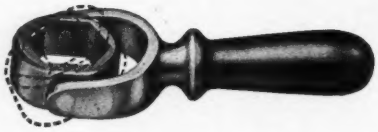

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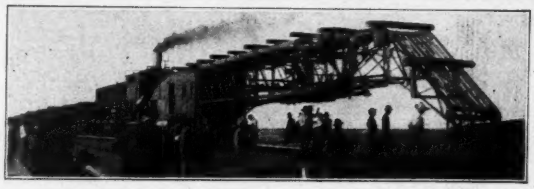

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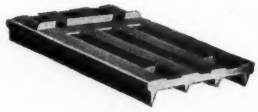
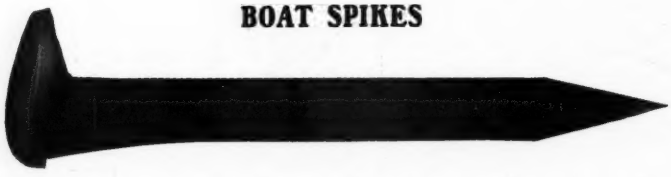


DILWORTH FLANGE PLATE

HARRIMAN PLATE

Standard and Special Railroad Spikes

BOAT SPIKES



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